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ABSTRACT

The goal of environmental education is to develop an environmentally literate citizenry, thus environmental education focuses on empowering individuals to deal effectively with positive and negative relationships between people and their environments. In 1993, the Secretaries Advisory Group on Environmental Education (SAGEE) subcommittee on environmental literacy developed its environmental literacy benchmarks project. This document is the result of deliberations of the project over the following three years. The focus of this initial effort is the K-12 years of schooling and youth groups. The benchmarks in this document are standards established for knowledge, skills, and attitudes that indicate progress toward a mature environmental literacy. They are tools to be used in designing formal and nonformal curricula and programs and are also guidelines for use in developing assessment tools for programs and for marking individual progress. (JRH)

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Benchmarks On the Way to Environmental Literacy K-12

Developed by
Benchmarks for Environmental Literacy Project
of the
Massachusetts
Secretaries Advisory Group onf Environmental Education
(SAGEE)

for
School-based Educators
and
Leaders of Youth Organizations

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Benchmarks On The Way To Environmental Literacy

Table of Contents

Foreword p.2

Introduction p.4

Anatomy of an Environmental Literacy Benchmark p.9

Benchmarks Overview & Index p.11

Benchmarks for Grades K-4 —(E1-E27) p.21

Benchmarks for Grades 5-8 —(M1-M30) p.45

Benchmarks for Grades 9-12 —(S 1-S31) p.73
- Science-focused p.77
- Social Science-focused p.88
- Language Arts & Humanities-focused p.101

Appendices
- Process and Decision-making Skills Glossary p.105
- Using Environmental Literacy Benchmarks for Curriculum Development p.107
- Benchmarks Cross-referenced by Category p.109

Acknowledgements p.110

Foreword

Why Benchmarks For Environmental Literacy

The Problem

Environmental issues will be a central concern in the 21st century. Most social and economic issues will have a major environmental component. Environmental issues require new ways of approaching and resolving problems both locally and globally. It is becoming increasingly imperative that our citizenry have a well developed environmental literacy. That is, our citizens must have a strong working knowledge of how the natural systems of our planet work and how human activity affects and may be harmonized with the environment. They need the skills to investigate and evaluate problems, and to take effective action. They need to develop habits of mind that will enable them to become wise, empowered citizens who will act to keep the planet healthy and functioning in order to meet the needs of all its denizens.

The Challenge

Developing environmental literacy is a major task for us as a society. Many parts of our society—including home, family, school, community, church, workplace, interest groups, and the media—can play a major role. Achieving the necessary environmental literacy is a major task for our schools.

This document focuses on the roles that elementary, middle, and secondary schools can play in developing environmental literacy and will be followed by a second document that focuses on the role of higher education in assuring adequate levels of environmental literacy for college and university graduates.

Environmental education is the tool for developing environmental literacy. As a society we need to know how well our environmental education efforts are doing in developing increasingly sophisticated levels of environmental literacy.

Benchmarks are points of reference from which measurements may be made; standards by which progress toward a larger goal may be assessed. In this case, benchmarks are standards established for knowledge, skills and attitudes that indicate progress toward a mature environmental literacy.

A Response To The Challenge

We are encouraged by recent developments in school reform in Massachusetts . Statements in the Massachusetts Common Core of Learning (1994) suggest a potentially important role for environmental education and a recognition of the interdisciplinary nature of this learning. We are also encouraged by the efforts at reform under the PALMS project to emphasize instruction based on the knowledge that learners construct their own understanding through hands-on experiences that encourage the development of critical thinking skills and use authentic tasks of inquiry, reasoning, and problem-solving that reflect real world issues.

We do have concern, however, that in basing the curriculum frameworks process on traditional disciplines, the critical message of the need for interdisciplinary approaches to environmental issues will not be well conveyed to teachers. Our intent in this document is to contribute an interdisciplinary curriculum perspective that focuses on the development of environmentally literate citizens in Massachusetts schools.

We hope that this document will spark a productive conversation about how we will prepare today's young people to deal effectively with the critical environmental issues of the coming century. Comments on the document are welcome and encouraged. It remains a work in progress.

Trudy Coxe,
Secretary of Environmental Affairs

Introduction

Historical Background

In 1992, SAGEE (Secretaries Advisory Group on Environmental Education) established a subcommittee on environmental literacy. Its first report to the Secretary of Environmental Affairs was a document broadly outlining the scope of environmental literacy and the need to foster such literacy in Massachusetts. It strongly recommended that development of environmental literacy should be made one of the major goals of education within the Commonwealth.

In 1993, the subcommittee on environmental literacy developed its environmental literacy benchmarks project. This document is the result of deliberations of the project over the following three years. The focus of this initial effort is the K-12 years of schooling and youth groups. In 1996, the next phase of the project will be working on environmental literacy benchmarks for the post-secondary years.

The Challenge

The environmental literacy benchmarks subcommittee began by examining the Benchmarks in Science developed by Project 2061. The committee felt that the items presented in that document were not truly benchmarks but rather an elaborate system of content statements. Our definition of a benchmark focuses on tasks a learners can accomplish based on their comprehension of a body of knowledge, the ability to perform related skills, and use of some basic habits of mind. With that in mind the committee set about creating the set of benchmarks presented in this document.

It was further felt that acquisition of environmental literacy is a developmental process taking place over a lifetime; that is, there are degrees of environmental literacy that build and grow from simpler to more complex levels. Although development of environmental literacy is not strictly school dependent (the information and skills are acquired through a variety of

education venues), for our purposes it seemed easiest to develop our benchmarks around clusters of school grade levels. Those chosen are grades K-4, grades 5-8, and grades 9-12.

Such a grade cluster based approach implies a well coordinated curriculum structure K-12. We are quite aware that such does not exist however much one might desire it. As stated, environmental literacy is developmental. Generally, one acquires the simple things before moving to the more complex. In guiding a learner's development it is important to assess where the learner is at the moment and guide the learning forward from that point. One cannot assume that because learners have been exposed to a particular grade level that they have acquired the environmental literacy benchmarks of that level. A teacher/youth leader may need to modify program to help the learners achieve benchmarks that perhaps should have been acquired earlier.

The Result

Benchmarks are essentially learning goals and objectives. They do not constitute a curriculum. Many different instructional approaches and venues may be employed to help learners achieve any particular benchmark. Benchmarks are tools to be used in designing formal and nonformal curricula and programs. They are also guidelines for use in developing assessment tools for programs or for marking individual progress.

The Hope

It is the SAGEE Environmental Literacy Subcommittee's hope that these Benchmarks will receive broad acceptance and will be an aid to curriculum coordinators, classroom teachers, and non-formal program developers in creating and implementing curricula and programs for our young people that will assure their development as active and effective environmentally literate citizens of this planet.

Environmental Education and Literacy

Environmental education is a process aimed at developing a citizenry that is aware of and concerned about the total environment and its associated problems, and which has the knowledge, attitudes, motivations, commitments and skills to work individually and collectively toward the solution of current problems, as well as the prevention of new ones. ***The goal of environmental education is to develop an environmentally literate citizenry, thus environmental education focuses on empowering individuals to deal effectively with positive and negative relationships between people and their environments.*** Environmental education is designed to foster and nurture growth of ENVIRONMENTAL LITERACY throughout the human life span.

All of our material needs, and many of our emotional and spiritual ones, are met from our bio-physical and social environments. The quality of the environments affects the quality of our lives. Our actions as producers, consumers, voters, recreators, and procreators have a cumulative impact on the quality of the environments that sustain us. Our future, and the future of generations yet unborn, depends on choices we each make on a day to day basis. It is essential that our educational system develop and nurture environmentally literate citizens. ***Environmental education differs from environmental advocacy in empowering people with the knowledge, skills, and attitudes needed to make informed choices rather than advocating specific choices.*** Environmental education is a life long process. As people develop, grow and learn, they gain increasingly sophisticated insights into the functioning systems of our planet and the ways in which humans interact with them.

Environmentally literate people know and understand:

- the physical processes that shape the patterns of the Earth's surface;
- the characteristics and spatial distribution of ecosystems on Earth's surface;
- the characteristics, distribution, and migration of human populations on Earth's surface;
- the patterns and networks of economic interdependence on Earth's surface
- the processes, patterns, and functions of human settlement;
- how human actions modify the physical environment;

- how physical systems affect human systems
- the changes that occur in the perception, use, distribution, and importance of resources;

Environmentally literate people also share a variety of <u>skills.</u>

These include:

- accessing objective, reliable information relevant to specific issues;
- communicating information to others effectively;
- making thoughtful choices from among a range of alternatives;
- working effectively with others to bring about needed changes;
- and a range of basic process and decision making skills such as:

Process skills

- observing
- inferring
- measuring
- critical thinking
- communicating
- estimating
- analyzing
- drawing conclusions
- classifying
- predicting
- compare & contrast
- creative thinking
- interpreting data
- categorizing
- synthesizing
- cooperative skills

Decision-making skills

- formulating operational definitions
- generating relevant questions
- gathering verifiable information
- suggesting potential alternative solutions
- projecting consequences of each alternative
- choosing among alternatives
- acting on choice
- cooperative problem solving

Environmentally literate people also tend to share certain <u>habits of mind,</u> in that they:

- look for the various systems that are involved in issues that concern them;
- seek the historical development and background of issues as well as their current status;
- are open to new ideas;

- remain healthily skeptical of quick fix solutions;
- anticipate the potential consequences of a variety of action alternatives before selecting one;
- look for connections and interconnections among issues;
- investigate the historical development of an environmental issue; and
- seek and treat root causes rather than superficial symptoms of dysfunctional systems

Sound environmental education leads to action, the things we do as consumers, producers, recreators, procreators, and voters. That is, environmentally literate individuals make choices and take day to day actions that will conserve and enhance the ability of the environment to sustain functioning ecosystems and meet human needs now and for generations yet to come. Actions may be as simple as seeing that trash is put in proper containers or more complex activities such as working to promote proper use of rain forest resources or facilitating recycling activity.

There is a rough pattern of how people progress in their development of environmental literacy that can be divided into three levels —nominal, functional, and operational. **Nominal** implies basic cognitive awareness and understanding; **functional** implies narrowly focused issue application; **operational** implies broad application in daily life. *By the completion of 12 years of schooling, the average graduate should have attained at least a* ***functional*** *level of environmental literacy.*

Anatomy of an Environmental Literacy Benchmark

The Benchmark Proper

• Presents a task learners should be able to do (preferably by the end of the designated grade level grouping).

* The task implies acquisition of significant knowledge.
* The task assumes certain skill developments have taken place.
* The task assumes development of specific habits of mind.
* The task contributes to basic positive environmental attitudes. and development of environmental ethics.

• Tasks are often presented in a generic framework that can be applied to a variety of specific issues or problems. Examples of specific issues are set off in italics and parentheses within the benchmark. Learners are not expected to be able to deal with all the examples, but should be able to do a respectable job on one of the examples or a similar related one.

• Each benchmark is assigned a letter and number for ease of reference—K-4 benchmarks use the letter E, 5-8 benchmarks use the letter M, and 9-12 benchmarks use the letter S.

The Content/Context Statement

• **The first sentence of each content/context statement is set bold.** The content statement provides a background context setter for the teacher/youth leader. It sets forth the basic concepts needed for understanding the nature of the benchmark task. It sets the basic parameters of understanding but it is not expected that the learners will all be able to deal with the benchmark at this level of sophistication. The content statement also serves as a guide around which teacher/youth leaders can develop rubrics for assessing degree of learner achievment of the benchmark task.

Process Categories

• Achieving a benchmark task requires the learner to use a variety of process and decision-making skills as well as certain habits of mind. Those skills and habits of mind implicit for each benchmark are listed under one of three process categories following the content statement. The categories are:

* Process Skills
* Decision-making Skills
* Habits of Mind

* A glossary of all the process and decision-making skills can be found at the end of the book.

Environmental Ethics

• Each benchmark makes a contribution to the development of aspects of an environmental ethic. The benchmark may expand development of:

* Environmental awareness
* Environmental understanding
* Stewardship
* Green consumerism
* Voluntary simplicity

Disciplinary focus

• The disciplinary focus of each benchmark is located in the right margin at the end of each benchmark discussion. It appears in smaller type than the rest of the discussion because it is of lesser importance except for some types of curricular planning. Environmental Literacy Benchmarks are, by their nature, essentially interdisciplinary. They normally draw upon information and understanding from more than one academic discipline. The disciplinary focus box simply indicates those disciplines which would contribute the larger share of information to the learners capacity to meet the benchmark task.

Benchmark Order

Elementary and middle schools are generally more comfortable with interdisciplinary study than high schools. Therefore the sequence of benchmarks, although clustered in some broad areas of study, are presented as an interdisciplinary mix and discipline areas are not indicated. However, since interdisciplinary approaches still seem a way off at the high school lever, the 9-12 benchmarks are grouped under separate disciplinary heading. This does not make them any less interdisciplinary in nature; it merely recognizes the realities of current secondary school structure.

Environmental Literacy Benchmarks Overview & Index

K-4 Benchmarks

E1: Learners can explain how humans are an integral part of the natural world influenced by and influencing natural processes. p.24

E2: Learners can give examples of diversity in nature and suggest the value and identify the benefits of such diversity. p.24

E3: Learners can explain, in a functional way, what systems are and demonstrate awareness that the living earth is a collection of interconnected ecological systems. p.25

E4: Learners can identify and explain the important elements of a habitat. They can give examples of several different kinds of habitat and describe local human habitats. p.26

E5: Learners can identify a variety of aquatic and terrestrial ecosystems and can tell what the living and non-living components of each ecosystem are. p.27

E6: Learners can explain how their activities affect their environment. They will be able to describe how and where their waste products are disposed of and who, or what, organisms and systems may be affected by those wastes.p27

E7: Learners can explain the ultimate source of all energy of our planet and identify the star that is the parent of planet Earth. p.28

E8: Learners can identify different sources of energy and can cite examples of how energy travels through a simple food chain and how energy moves from the sun to systems that humans consider to be "utilities" *(gas, oil, electricity)*. p.29

E9: Learners can identify different examples of energy transformation *(food to warmth, food to bodily activity, water to steam, photosynthesis, sunlight to hot sand, water to ice)* p.29

E10: Learners can identify a variety of long term and short term changes in the environment *(weather vs climate, night and day vs seasons, caterpillar skin shedding vs metamorphosis to a butterfly)*. They can identify changes caused by human activities and changes that are independent of human activities *(urban development vs daily tides, moon phases vs telecommunications)*. p.30

E11: Learners can observe plants and animals first hand *(or choose examples from a list of common species)* and identify features of their physical being , or their behavior, that help them to survive. Learners can "design" species for hypothetical environments using their knowledge of typical adaptations of existing species and environments. p.31

E12: Learners can develop a list of living things that are similar to their parents in appearance and those that are different from their parents in appearance. p.32

E13: Provided with several objects or organisms, the learner will be able to develop a simple dichotomous or visual identification key. p.32

E14: Learners can give many examples of kinds of changes that occur over short periods of time. (*leaves fall and decay, metals rust, dirt gets moved from place to place by erosion, people fight, insects eat plant leaves, snow falls and melts, birds migrate, kids lose and grow teeth, etc.*) Learners can demonstrate understanding that the Earth and living things are constantly changing and give an indication of how long it takes for those changes to occur. p.33

E15: Learners can give examples of the many different ways human communities interact with, and are dependent upon, the environment. They can explain the benefits and costs that people and the environment get from each of the interactions they list. p.34

E16: Learners can describe ways that human activities affect the environment we depend upon to meet our basic needs and desires. They can tell whether each described activity has a positive or negative affect on the environment. p.35

E17: The learner is able to select an appropriate map style and scale and will be able to create a personal *(mental)* map of an area on or near the school grounds which can be interpreted and understood by another learner. The learner also can interpret and understand the maps of other learners. p.35

E18: Learners can state what the roles of the key players in their social environment are *(parents or guardians, police, firemen, teachers, farmers, salespeople)* and what these people do to meet the learners needs and desires. They can also state how their lives might be affected if any of these roles is missing from the social environment. p.36

E19: Learners can portray/explain the basic interactions between humans and their environment in their own culture and a culture different from their own. They can express themselves through a play, poem, song or folktale.p.37

E20: Learners can create drawings and charts or create stories that illustrate how people and other animals, plants and other life forms, live in interacting and interdependent communities. p.37

E21: Learners can generate a list of non-traditional uses for a given object or material. p.38

E22: Learners can develop a list distinguishing basic needs from wants. p.39

E23: Learners can identify basic natural resources that are needed to sustain human life in our society. p.39

E24: Learners can give examples of renewable and non-renewable resources and explain the difference between the two categories of resources. p.40

E25: The learner will identify a school community challenge *(e.g. recycling opportunity, careless use of water, animal or plant overpopulation, soil compaction, need for physical recreation opportunities)* and propose a solution for that problem. p.41

E26: The learner will develop a procedure for investigating a common natural phenomenon. p.42

E27: Learners can name their favorite plants, animals, and places and tell why these things are their favorites and why people should try to protect these things for others to enjoy as well. p.43

5-8 Benchmarks

M1: Learners can choose plants and animals from a list of common species and explain how they are adapted to the environments in which they live. p.47

M2: Learners can demonstrate knowledge of the basic concept of an ecosystem, its biological and physical components. p.47

M3: Learners can identify and describe several of the interacting systems that make up their biophysical and social environments. p.48

M4: Learners can select an ecosystem from a listing of ecosystems and describe the major component parts of the system and describe the roles each part plays in the system. *(The list should include at least the following ecosystems:*

salt marsh/estuary; deciduous forest; inland or coastal watershed; urban ecosystem). p.48

M5: Learners can describe cyclic changes in the natural world *(seasonal changes, life cycles, phases of the moon, water cycle, carbon/oxygen cycle)* and compare common characteristics of identified cycles. p.49

M6: Learners can distinguish between renewable and non-renewable resources and explain the difference. p.50

M7: Learners can cite numerous examples of how materials in the environment are used over and over again over time, both in natural and human-generated systems *(i.e. from dead leaves to soil; recycled material to new products, carbon through photosynthesis and respiration in plants and animals, water through the water cycle).* p.50

M8: Learners can differentiate and explain the difference between a waste and a resource and give concrete examples of each. p.51

M9: Learners can state examples of materials in the environment that are perceived as natural resources to meet human needs and desires. They can give examples of items that are perceived as resources in our culture but not in some others. p.52

M10: Learners can describe an environmental change *(i.e. soil erosion, air quality degradation, species extinction)* and give a consequence of that change. p.53

M11: Learners can describe the possible affects on the survival of individual organisms and entire species brought on by changes in environmental conditions. p.54

M12: Learners can explain the effect of births, deaths, and emigrations on human populations and can cite examples of both positive and negative consequences of changes in regional populations. p.54

M13: Given common examples of change *(food to bodily activity, water to steam, photosynthesis)* learners can explain the ways in which the form and transformation of energy drives the changes. p.55

M14: Provided with several objects or organisms and the appropriate key(s), the learner will identify the organisms or objects. p.56

M15: Learners can cite examples of how to manage a system by changing its variables. p.57

M16: The learner will choose and use appropriate technologies *(thermometers, soil augers, computers, photography)* to gather and record observations regarding a complex system *(e.g. the atmosphere or an ecosystem)* and use the observations to make predictions about the effects of changes made in various components of that system. p.57

M17: Learners can give examples of how the organization of systems *(physical systems, biological systems, social systems)* becomes more and more disorganized if energy is not regularly invested to maintain the basic functional organization. p.58

M18: Learners can identify patterns of change in the natural and technological world as trends *(i.e. more development leads to reduced forest habitat)*, cycles *(changes of state in water gives us the water cycle)*, or chaos *(uncontrolled urban migration)*. p.59

M19: Presented with data on the consumption pattern of a resource in the local community, the learner will propose *(e.g. written proposal, persuasive materials, videos)* a strategy to manage the resource more efficiently and economically. p.60

M20: Learners can explain ways in which humans impact the environment and cite multiple examples of technologies *(i.e.chemical manufacture, heavy construction equipment, mechanical transportation, etc.)* that extend human abilities to alter the environment. p.61

M21: Learners can compare the rate of resource consumption per capita between the United States and at least one, third-world nation and give examples of the potential consequences of each country's rate of resource consumption to the global environment over the next few generations. p.62

M22: Given examples of common choices people can make regarding the use of everyday technologies *(choosing natural vs synthetic fibers for clothes, bicycles vs cars, computers vs pencil and paper)*, learners can project likely consequences of the alternative actions. p.63

M23: The learner will identify a community environmental problem *(e.g. recycling, loss of water quality, animal and plant overpopulation and competition, extinction of species, unregulated urban growth, soil depletion or erosion, transportation issues, loss of physical recreation opportunities)*

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and propose a sólution for that problem using information collected to support his or her proposal. p.64

M24: Given a product (a snack food, clothing material, cleaning product, etc.) learners can locate sources of information through which they can evaluate and determine the general impact of that product on their health and the health of the environment. p.65

M25: Given a local environmental issue of their choosing, learners can create a listing of the expected economic, social, and ecological costs and benefits of alternative proposals for resolving the issue. p.66

M26: Given the observations of several witnesses to an environmental event or issue, along with related evidence, the learner can distinguish the various perspectives presented and their influence on general explanations of the event or environmental issue. p.67

M27: Given a learner-identified issue of local community importance *(e.g. air pollution, pesticides, chemical exposure, radon, abandoned hazardous waste sites, high-voltage transmission lines, landfills, lawn management),* the learner will collect information and observations and take action on a decision made regarding the issue. p.67

M28: The learner will construct, test, and trouble-shoot a set of procedures for younger learners to use for investigating a common natural phenomenon. p.69

M29: Learners can examine their local, regional, or global surroundings and indicate examples of inequities of access to resources, sitings of pollution cleanup facilities, distribution of resources, or other environmental inequities. They can also suggest ways in which these situations could be made more equitable for all. p.69

M30: Learners can give concrete local and global examples to explain the concept that "Environmental quality is the net sum of the consequences of individual and group actions." p.70

Benchmarks 9-12

S1: The learner will identify and explain the major layers of Earth's overall ecosystem *(atmosphere, lithosphere, hydrosphere, biosphere)* and how each plays a role in the maintenance and survival of living things. p.75

S2: Learners can describe the key features of the major kinds of terrestrial biomes of the planet *(taiga, boreal forest, temperate deciduous forest, rain forest, grasslands, and desert)* and can roughly plot the locations of these biomes on a world map. p75

S3: Learners will distinguish and explain the differences among various kinds of soils (*type, origin, structural features)* and explain the capacity of different soils for human use and survival of all living things. p.76

S4: Learners can identify and explain the importance of the major aquatic biomes of Earth *(deep ocean, coastal ocean, estuarine, riverine systems, lakes, ponds, swamps and bogs)* and locate them on a world map. p.77

S5: Given any of a range of habitats *(lawn, garden, forest, field, stream, etc.)* students will be able to sketch out the major biogeochemical cycles *(carbon, water, nitrogen, phosphorus, etc.)* that affect that habitat and explain their role in the health and survival of living organisms in that habitat. p.77

S6: Learners can explain through concrete examples how the processes of photosynthesis and respiration work in concert to allow the continuation of life on earth. p.78

S7: Learners can explain the causes and consequences of exponential growth on a variety of living things *(yeast, fruit flies, bacteria,humans).* p.79

S8: Using examples from their local communities, learners can demonstrate through drawings and/or photographs how communities and ecosystems change through succession. They can identify various stages of succession, identify a number of ecological niches in each stage, describe key food chains and webs for each stage, and describe the ways nutrient cycling is involved in the transitions from one successional stage to another. Learners can predict the likely successional pattern if the current successional stage is destroyed. p.80

S9: Learners can explain how both continental and local air flow patterns can influence distribution of airborne pollutants. They can predict where local air pollutants are likely to spread due to major weather patterns, whether the source of the pollution is hundreds of miles away or local. They can recognize the conditions that will lead to temperature inversions that put many people at high risk of respiratory illness , cancers, and other bodily stresses. Learners also can site some of the consequences of air pollution for organisms and structures. p.81

S10: Given one or more types of ecosystem, learners can construct a flow chart of energy through the system using their understanding of food chains, webs, and pyramids of numbers and biomass. p.82

S11: Learners can trace the energy flow within an ecosystem and demonstrate knowledge of the roles of producers, consumers, and decomposers in ecosystems. p.83

S12: Learners can describe the major ecosystems that exist in the watershed *(drainage basin)* in which their community is located. They can state the major stress factors that are most likely impacting those ecosystems, explain how people have simplified many of the ecosystems leaving them more susceptible to stress and disease, and how people have acted to enhance the stability and adaptability of some of those ecosystems. p.83

S13: Learners can explain how natural recycling occurs with the decay of logs, leaves, and other organic material in a forest and can describe how recycling of "waste" materials of our consumer society is as essential to sustainability of our society as recycling of logs and leaves is to sustainability of a forest ecosystem. p.84

S14: Learners can select an environmental problem of local concern *(i.e. deforestation, industrial pollution, urban overcrowding, water pollution, and the like)* and explain how the local problem is part of similar regional, national, and global issues. The learner can state some of the ways the problem is being addressed at all these levels. p.85

S15: Learners can describe several alternative approaches to pest control *(genetic resistance, natural enemies, bio-pesticides, integrated pest management, and the like)* and can state precautions that need to be taken in selecting, using, storing, and disposing of different classes of pesticides *(chlorinated hydrocarbons, organophosphates, carbamates, botanicals, contact chemicals, systemic chemicals, soil sterilants, fungicides, and fumigants)* . p.86

S16: Given an environmental issue of their choice, learners can state:
- why management of human use of the resource is needed;
- what human goals, values, and needs are at stake;
- who the management groups or individuals are likely to be; and
- what kind of scientific knowledge and technical skills are likely to be needed

to accomplish sound management of the resource. p.88

S17: Given a local environmental problem *(i.e. solid waste disposal, open space preservation, loss of biodiversity, ground water pollution)*, learners can identify the issues involved, the key players and their viewpoints, assemble

factual information, generate alternative solutions, project consequences of each solution, choose among the alternatives, and act on their choices. p.89

S18: Given a choice of environmental problems *(preferably local ones)*, learners determine the historical development of the problem and the issues that have been generated around the problem. They can further describe how the historical development of the problem shaped the current problem and can then distinguish root causes from current symptoms. p.90

S19: Using an understanding of ecological, sociological, economic and political systems, learners can describe the complex relationships between and among such systems. p.91

S20: Learners are able to locate the watershed in which their home and school are located and draw its rough boundaries on a topographic map. They can determine in what major drainage basin that watershed is located and they can also indicate the major ecosystems, resources, and major towns and cities that occur in that drainage basin. p.92

S21: Given a set of lifestyle descriptions from different cultures, ancient and modern, learners can determine from those descriptions which aspects of the lifestyles are ecologically and economically sustainable and which contribute significantly to environmental degradation. p.93

S22: Given examples of past and present societies *(e.g., Cro-magnon, !Kung, Babylonian, Mayan, Amish, American)* learners can describe the major types of relationships, energy usage, and resource impact that humans demonstrated towards the environment. They can also describe how each society's attitudes and understandings of the functioning of nature influenced the impact of that society on their environment. p.94

S23: Given a war of their choice *(i.e. American civil war, World War II, Korean or Vietnam wars, Mexican/American war, the French & Indian wars)*, learners can explain the effects that war has had on the cultures and environments of all parties to that war. p.95

S24: Given a local environmental issue, learners can describe the range of political options available to resolve it, state the political costs and benefits of each, and state the options they support under the circumstances, and why. p.95

S25: Given an environmental issue *(such as toxic waste plant siting, lead paint, asbestos removal, land use restrictions for endangered species)* the learner can identify related "equity " issues and suggest ways they may be addressed in a fair manner. p.96

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S26: Learners will be able to explain how birth rate, death rate, fertility rate, and immigration influence the growth of a population within a state or nation. Learners can predict how rate of growth impacts economic systems, ecosystems, political systems, and social systems. Learners can read and interpret graphs of age and sex structure of a local population and indicate how the data will impact future needs of the community for schools, cemeteries, and other needs that will impact the local environment. p.98

S27: Learners can select a suggested solution to a local environmental issue of their choice and prepare a risk/benefit analysis of that particular solution. The learner can explain the risks and benefits of the solution to others and offer a reasoned opinion of the potential usefulness of that particular solution. p.99

S28: Given an environmental issue of their choosing, learners can cite some local, state, and national laws that address that issue and describe the degree of impact the laws have had in addressing the issue. Learners can also suggest ways they believe some of the laws should be altered to be more environmentally effective and/or socially equitable. p.100

S29: Learners using a diversity of examples can demonstrate their understanding of different environmental ethics that are practiced within societies currently or throughout history. p.101

S30: Learners can articulate and defend an environmental ethic and give examples of how that ethic impacts choices they make in their daily lives. p.102

S31: Given a novel or short story, television or movie drama, the learner can infer or recognize the environmental setting of the fiction and give an opinion of how that environment affected the development of the story and the lives of the chief characters. p.103

Benchmarks of Environmental Literacy
For Grades K-4

Introduction

The K-4 grouping focuses on environmental awareness and the development of positive attitudes toward the world of nature and human society. Students focus on basic concepts about the structure of the environment and its role in their lives.

Perspective

Environmental education in Grades K-4 should build on children's natural curiosity and enthusiasm for nature. This is the time to develop awareness of the natural world, respect for this planet's organisms and processes, and the beginnings of understanding of how the natural world works. For environmental education, process is equally as important as content; content is embedded in the learning process.

> *"The challenge for educators is to capitalize on the interest that students have in living things while moving them gradually toward ideas that make sense out of nature. Familiarity with the phenomena should precede their explanation, and attention to the concrete object should precede abstract theory. ...Thus, children should experience a concept before being told its name. Scientists came to understand the living environment first through observations, then classifications, then theories. It's a useful model for students to follow in learning about the environment."*
>
> Project 2061
> Benchmarks for Science Literacy

Children learn about the natural world by experiencing it. It is important to get these vibrant young learners out into nature, and also to bring some of it into the classroom. Through these real life, hands-on experiences students will generally come to love the environment, to understand it, to value it, and ultimately to take responsibility for its welfare. Learning from and about the surrounding

environment taps into every mode of learning: cognitive, affective, social, physical, and expressive. Children who are encouraged to use all of these different modes for learning become effective learners and doers.

Options

Ideally, environmental education is a way of looking at the world that helps kids grow in every part of their brains, bodies, and spirits. Environmental education can be integrated into all the curricular subjects, providing experiences in math, language, social studies, and all the arts.

By the end of the 4th Grade children should be "hooked on nature," have acquired some basic tools for investigating the natural world, and have some fundamental knowledge of how basic natural and social systems work. After 5 years of such a program, children will arrive in fifth grade

- firmly grounded in basic environmental knowledge, skills, and habits of mind
- self-directed in their outdoor explorations
- respectful of all forms of life
- beginning to recognize the human impact on the natural world
- eager to learn more
- well-prepared for the more complex schooling ahead.

This should put them well on their way to Nominal Environmental Literacy.

The benchmark guides that follow **do not** constitute a curriculum. They represent concepts, skills, and insights about environmental relationships that a youngster should possess by the time he or she leaves fourth grade. They are components of environmental literacy appropriate to the developmental level of most primary grade students.

There are various ways experiences, materials, and lessons may be organized so that students develop these understandings over the years represented by these grades. It is not in the purview of this document to recommend one approach over another. That is the proper role of the local school district. However, it should be understood that there are basically three levels of development for each benchmark—**introduction** of key concepts and skills,

expansion of understanding and skill, and **mastery** of both concepts and skills. Different aspects of this sequence may take place over the K-4 grade span. It is important, however, that by the end of fourth grade students should be able to demonstrate their understanding of and competency with these understandings, ideas, and skills.

Benchmark Structure

Each benchmark is stated from an outcome-based position. The overall benchmark statement includes a brief content statement and a set of items for **process skills, decision-making skills, habits of mind, and environmental ethics**. The items are ones with which a learner will need to be reasonably proficient in order to meet the benchmark performance standards .

There is no hierarchy of benchmarks—that is, no one is more or less important than another; all are important for true environmental literacy development. Numbers are assigned to each benchmark only for reference ease. All should be addressed over the primary grade span. In many ways the benchmarks serve as an assessment tool to determine the degree to which environmental education has been successful. Students will vary considerably in their level of mastery of a benchmark but overall the class should achieve and demonstrate advancement to a nominal level of environmental literacy over the 5 year span.

BENCHMARKS K-4

E1: Students can explain how humans are an integral part of the natural world influenced by and influencing natural processes.

Content/Context

Humans are an integral part of the natural world. They are affected by factors in their environment and they, in turn, affect that environment.

Human interactions with the environment are as "natural" as the interactions of any other living thing -- plant or animal. Cities and other human-built environments, are as natural as a wasp's nest or a coral reef which are built environments engineered by other organisms. Any built environment modifies the environment within which it is constructed. All changes, big or small, have their consequences.

Process skills

- observing
- classifying
- inferring
- compare & contrast
- communicating
- analyzing
- drawing conclusions

Habits of mind

- curiosity
- openness to new ideas
- skepticism
- reliance on data, facts & observations
- looks for connections
- projects likely consequences of actions

Environmental ethics

- environmental awareness
- environmental understanding

Disciplinary focus

- science
- social science

E2: Learners can give examples of diversity in nature and suggest the value and identify the benefits of such diversity.

Content/Context

Living things come in many different forms, shapes, sizes, colors. In some cases having a different form, shape or color, can be helpful to an organism; in other cases it is simply an interesting variation. The stability of an environment is often directly related to the amount of diversity because

some species may be more vulnerable to certain environmental problems or stresses than others.

Nature has many ways to do the same things. Each way is adapted to different sets of conditions. Different organisms fill slightly different roles in the local web of life. Sets of different organisms form communities of living things. The more diverse the life forms the greater the number of ways of getting the basic jobs done of circulating materials and energy. If there is only a limited number of organisms in a community, each with its own role to play, the likelihood increases that the whole community will collapse if something drastic happens to one of the players. Where there is greater diversity, there is a higher chance that one of the other players can take over the role of one of the players that is crippled or eliminated.

Process skills
- observing
- classifying
- inferring
- predicting
- critical thinking
- drawing conclusions

Habits of mind
- looks for connections
- projects likely consequences of actions

Environmental ethics
- environmental awareness
- environmental understanding

Disciplinary focus
- science

E3: **Learners can explain, in a functional way, what systems are and demonstrate awareness that the living earth is a collection of interconnected ecological systems.**

Content/Context

Organisms and the non-living world interact to exchange materials and energy. A collection of plants, animals, and non-living environmental materials that interact to exchange materials and energy in a particular location form basic systems. Systems tend to interact with other systems; that is, a forest system may interact with a field system, or a pond system. A city system will interact with a suburban systems or with a river system. Each of these is a small ecosystem. Earth is a huge ecosystem made up of thousands, perhaps millions of smaller ecosystems.

Systems, including ecosystems, are made up of regularly interacting and interdependent parts that form a unified whole and together tend to accomplish specific functions.

Process skills
- classifying
- inferring
- critical thinking
- communicating
- synthesizing

Habits of mind
- openness to new ideas
- looks for connections

Environmental ethics
- environmental awareness
- environmental understanding

Disciplinary focus
- science

E4: **Learners can identify and explain the important elements of a habitat. They can give examples of several different kinds of habitat and describe local human habitats.**

Content/Context

Every living thing has to have a habitat which provides the things it needs to survive. All animals, including humans, have certain basic needs (food, water, shelter, space). The specific things a plant or animal needs vary from one species to another. If a habitat has only some of the needed components, then the plant or animal will not be able to survive there for long periods. For every need there is a range of tolerance within which the organism can survive. There can be too much or too little of the item that fulfills the need. Some needs are more critical to survival than others and the availability of those materials will be most critical in determining the suitability of a particular habitat for a given species.

Process skills
- classifying
- inferring
- predicting
- compare & contrast
- critical thinking
- analyzing
- synthesizing

Habits of mind
- openness to new ideas
- reliance on data, facts & observations
- looks for connections

Environmental ethics
- environmental awareness

- environmental understanding

Disciplinary focus
- science

E5: **Learners can identify a variety of aquatic and terrestrial ecosystems and can tell what the living and non-living components of each ecosystem are.**

Content/Context

Ecosystems consist of people and other animals, plants and other life forms, and abiotic factors interacting and interdependent in a wide variety of ways. Environments differ depending upon climate and geology which in turn set the limits for the specific plant/animal communities which may be found there. Characteristics of different physical environments provide for, or place constraints on, activities of different organisms. Living things are found almost everywhere in the world with each species having features and behavioral strategies that help it thrive in its particular environment. Animal species interact with each other in many different ways and matter moves between the living and non-living entities, but overall remains constant in amount.

Process skills
- observing
- classifying
- categorizing
- analyzing

Decision-making skills
- formulating operational definitions
- generating relevant questions

Habits of mind
- reliance on data, facts & observations

Environmental ethics
- environmental awareness

Disciplinary focus
- science

E6: **Learners can explain how their activities affect their environment. They will be able to describe how and where their waste products are disposed of and who, or what, organisms and systems may be affected by those wastes.**

Content/Context

Human activities affect the environment. Some activities may destroy or alter habitat for certain plants or animals. Growing populations, increasing per capita consumption and/or poor management are depleting the Earth's natural resources. Air, water and soil can be damaged by human activities. Every action produces some effects: some are beneficial, some are harmful;

some are predictable, some are not. Humans can reduce their impact on the environment: avoidance of pollution is better than treatment of pollution. There is no AWAY into which to throw our wastes. Some will decompose into components that can be reused by organisms. Other waste products do not break down or break down into materials that are harmful to the environment.

Process skills
- observing
- inferring
- predicting
- critical thinking
- interpreting data
- analyzing
- drawing conclusions

Habits of mind
- skepticism
- reliance on data, facts & observations
- looks for connections
- projects likely consequences of actions

Environmental ethics
- stewardship
- voluntary simplicity
- "green" consumerism

Disciplinary focus
- science
- geography

E7: **Learners can explain the ultimate source of all energy of our planet and identify the star that is the parent of planet Earth.**

Content/Context

Earth and the other planets all have their basic materials from their star parent, the sun. The sun also is constantly giving off energy some of which reaches the planets and gives them a dose of energy that will affect their temperatures among other things. On Earth, plants have developed ways to capture the sun's energy for their own use. Plant energy is passed on to animal life through food chains and webs. Solar energy also warms air and water and temperature differences create wind and water currents that shape our weather and climate.

Process skills
- classifying
- inferring
- categorizing

Habits of mind

- curiosity
- openness to new ideas
- looks for connections

Environmental ethics

- environmental awareness

Disciplinary focus

- science

E8: **Learners can identify different sources of energy and can cite examples of how energy travels through a simple food chain and how energy moves from the sun to systems that humans consider to be "utilities"** *(gas, oil, electricity).*

Content/Context

The sun is the direct or indirect source of all our energy. Energy from the sun warms the land, air and water. Some of the energy is received as heat. Some of the heat affects air temperature making air currents flow across the Earth. In some cases extreme temperature variations can cause storms. Over millions of years some of the solar energy has been stored in fossil fuels such as coal, peat, petroleum and natural gas. Energy from the sun triggers photosynthesis allowing plants to produce sugars which are used for growth and are utilized by other species that consume the plant or subsequently consume the consumers. Living things can be classified as producers, consumers, and decomposers.

Process skills

- classifying
- critical thinking
- categorizing
- analyzing
- drawing conclusions

Habits of mind

- curiosity
- looks for connections

Environmental ethics

- environmental awareness

Disciplinary focus

- science

E9: **Learners can identify different examples of energy transformation** *(food to warmth, food to bodily activity, water to steam, photosynthesis, sunlight to hot sand, water to ice).*

Content/Context

Energy is what drives change. Most of what goes on in the universe—from exploding stars and biological growth to the operation of machines and

the motion of people—involves some form of energy being transformed into another. Energy appears in different forms—heat, chemical, mechanical, electrical, nuclear. Energy can change from one form to another in living things. Animals get energy from oxidizing their food, releasing some of its energy as heat. Almost all food energy comes originally from sunlight. Heat energy carried by the ocean and atmospheric currents has a strong influence on climate around the world.

Process skills
- observing
- inferring
- predicting
- critical thinking
- creative thinking
- communicating
- analyzing
- synthesizing
- drawing conclusions

Habits of mind
- curiosity
- openness to new ideas
- looks for connections
- projects likely consequences of actions

Environmental ethics
- environmental awareness
- "green" consumerism

Disciplinary focus
- science

E10: **Learners can identify a variety of long term and short term changes in the environment** *(weather vs climate, night and day vs seasons, caterpillar skin shedding vs metamorphosis to a butterfly).* **They can identify changes caused by human activities and changes that are independent of human activities** *(urban development vs daily tides, moon phases vs telecommunications).*

Content/Context

Change is constant. Change may be steady or erratic; repetitive or irregular. Many changes form repeating patterns or cycles. Some changes are rapid (earthquakes, storms) others are slow (movement of glaciers, formation of mountains, evolution of new species). Life involves recognizing and responding to and adapting to the many changes that occur in the environment. Basically, matter cannot be created or destroyed but it can be transformed in many ways.

Process skills

- observing
- predicting
- critical thinking
- communicating
- interpreting data
- categorizing

Habits of mind

- skepticism
- reliance on data, facts & observations
- looks for connections
- projects likely consequences of actions
- investigates historical development of issue

Environmental ethics

- environmental awareness
- environmental understanding

Disciplinary focus

- science
- social science

E11: **Learners can choose plants and animals from a list of common species** *(or choose examples from a list of common species)* **and identify features of their physical being , or their behavior, that help them to survive. Learners can "design" species for hypothetical environments using their knowledge of typical adaptations of existing species and environments.**

Content/Context

Plants and animals are adapted to the environments in which they live. Living things are found almost everywhere in the world with each species having features and behavioral strategies that help it to thrive in its particular environment. Animals and plants have a great variety of body designs and internal structures that contribute to their being able to make or find food and reproduce. Individual organisms with certain traits are more likely than others to survive and have offspring. Changes in environmental conditions can affect the survival of individual organisms and entire species. Like other animals, human beings have body systems for obtaining and providing energy, defense, reproduction, and the coordination of body functions.

Process skills

- observing
- classifying
- inferring
- predicting
- creative thinking
- communicating
- synthesizing

Habits of mind
- curiosity
- looks for connections
- projects likely consequences of actions

Environmental ethics
- environmental awareness
- environmental understanding

Disciplinary focus
- science

E12: **Learners can develop a list of living things that are similar to their parents in appearance and those that are different from their parents in appearance.**

Content/Context

The lives of living things have a beginning, a middle and an end. Most living things have a point of beginning (birth), a mid-section of life (reproductive capability) and a cessation of life (death). Dead things decay. Decay, in turn, supports a renewal of life. All living organisms have the potential to reproduce. Physical and some behavioral likenesses between parent and offspring (color, shape, migration behaviors) are inherited; other likenesses (such as carpentry skills, fondness for certain types of music) are learned. Juvenile forms may be similar to the adult form or very different. In both cases the adult form will resemble its parent. Decomposers recycle the components of things that have died into raw materials for the growth of new organisms.

Process skills
- observing
- classifying
- predicting
- compare & contrast
- creative thinking
- communicating

Habits of mind
- curiosity
- looks for connections
- investigates historical development of issue

Environmental ethics
- environmental awareness
- environmental understanding

Disciplinary focus
- science

E13: **Provided with several objects or organisms, the learner will be able to develop a simple dichotomous or visual identification key.**

Content/Context

Humans create frameworks and classifications to help them to organize large quantities of information. A key is a simple tool for organizing information which helps people look at similarities and differences between objects and use these features to classify them.

Process skills

- observing
- classifying
- compare & contrast
- critical thinking
- categorizing

Habits of mind

- reliance on data, facts & observations

Environmental ethics

- environmental awareness

Disciplinary focus

- science

E14: **Learners can give many examples of kinds of changes that occur over short periods of time.** *(leaves fall and decay, metals rust, dirt gets moved from place to place by erosion, people fight, insects eat plant leaves, snow falls and melts, birds migrate, kids lose and grow teeth, etc.)* **Learners can demonstrate understanding that the Earth and living things are constantly changing and give an indication of how long it takes for those changes to occur.**

Content/Context

Change seems to be the most constant thing in the universe. Changes go on around us all the time. Some change is rapid and people are generally aware of these changes. Other change takes place slowly over much longer periods of time and people are often not aware of such changes. Each change has a consequence and people and other living things have to be able to adapt effectively to changes if they are to survive. The consequences of any particular change may be a benefit to something or a real cost. What is a cost to one thing may be a benefit to another.

Process skills

- observing
- inferring
- predicting
- measuring
- compare & contrast
- critical thinking
- analyzing
- synthesizing

- drawing conclusions

Habits of mind
- openness to new ideas
- reliance on data, facts & observations
- looks for connections
- projects likely consequences of actions

Environmental ethics
- environmental awareness
- environmental understanding

Disciplinary focus
- science

E15: **Learners can give examples of the many different ways human communities interact with, and are dependent upon, the environment. They can explain the benefits and costs that people and the environment get from each of the interactions they list.**

Content/Context

People get materials for food, shelter, water, and social interaction from their environment. Human activities often create pollutants, habitat destruction, and resource depletion that may damage the environment. Alternative human activities may reduce pollution, restore habitat, and reduce the rate of resource depletion. Humans generally have choices in their activities and can choose to live in ways that sustain a healthy environment or ways that deplete the environment for this and future generations.

Process skills
- observing
- inferring
- critical thinking
- creative thinking
- communicating
- estimating
- analyzing

Habits of mind
- openness to new ideas
- reliance on data, facts & observations
- looks for connections

Environmental ethics
- environmental awareness
- environmental understanding

Disciplinary focus
- science
- social science

E16: **Learners can describe ways that human activities affect the environment we depend upon to meet our basic needs and desires. They can tell whether each described activity has a positive or negative affect on the environment.**

Content/Context

Every human activity has environmental consequences. Some of those consequences are beneficial to the environment; some have little significant impact; while others have distinctly negative impact on the environment and its ability to support and sustain living things including people. The quality of the environment at any given time is the net sum of the consequences of human activities and the consequences of other major environmental forces such as storms and earthquakes.

Process skills

- observing
- inferring
- compare & contrast
- critical thinking
- analyzing
- synthesizing
- drawing conclusions

Habits of mind

- looks for connections
- projects likely consequences of actions

Environmental ethics

- environmental awareness

Disciplinary focus

- science
- social science

E17: **The learner is able to select an appropriate map style and scale and will be able to create a personal *(mental)* map of an area on or near the school grounds which can be interpreted and understood by another learner. The learner also can interpret and understand the maps of other learners.**

Content/Context

Maps are stylized pictures and are tools which help people to represent graphically places that are too big, too small, or too complex to explain solely in words. There are many different styles and scales of maps, each designed to serve a particular purpose. Many different kinds of information can be communicated on a map in a non-linear fashion.

Process skills

- observing
- inferring
- measuring
- compare & contrast

- creative thinking
- communicating
- estimating
- categorizing
- synthesizing
- cooperative skills

Habits of mind

- reliance on data, facts & observations
- looks for connections

Environmental ethics

- environmental awareness

Disciplinary focus

- science and mathematics
- geography

E18: **Learners can state what the roles of the key players in their social environment are (*parents or guardians, police, firemen, teachers, farmers, salespeople)* and what these people do to meet the learners needs and desires. They can also state how their lives might be affected if any of these roles is missing from the social environment.**

Content/Context

Other people are key parts of anyone's environment. The relationships one has with other people affect how a person feels about him or herself and his or her place in society and the environment in general. Different people play different roles in the complex web of human social environments. Some people provide necessary products to meet human needs and desires; others provide basic services such as teaching or protection. Some people provide only one major role in the society; others have multiple roles. People usually interact with the biophysical environment through their roles in the social environment.

Process skills

- observing
- classifying
- compare & contrast
- critical thinking
- creative thinking
- communicating
- categorizing
- analyzing
- cooperative skills

Habits of mind

- curiosity
- looks for connections

Environmental ethics

- environmental awareness
- stewardship

Disciplinary focus
- social science

E19: **Learners can portray/explain the basic interactions between humans and their environment in their own culture and a culture different from their own. They can express themselves through a play, poem, song or "folktale."**

Content/Context

Human communities interact with and depend on the environment in many different ways. Humans have needs (basic food, clothes, shelter and social needs) and wants (a camera or television set). Many people in the world do not have enough money or basic resources to meet all of their needs and wants. Human needs are met through the use of natural resources (food, water, other materials) The way in which needs are met may be exploitive or sustainable. Resources are limited. The amount available is the total amount divided by the number of individuals to be served. Culture affects how needs are met, use of resources, ownership of resources, and sharing. The division of resources in the world is not equal. The more people there are, the fewer resources are available per person. People and nations are interdependent, sharing resources, technology and space.

Process skills
- observing
- inferring
- compare & contrast
- creative thinking
- communicating
- interpreting data
- analyzing

Habits of mind
- openness to new ideas
- reliance on data, facts & observations
- projects likely consequences of actions
- investigates historical development of issue

Environmental ethics
- environmental awareness
- stewardship

Disciplinary focus
- interdisciplinary

E20: **Learners can create drawings and charts or create stories that illustrate how people and other animals, plants and other life forms, live in interacting and interdependent communities.**

Content/Context

All living things and the non-living environment interact with each other in both simple and complex ways. Basically they interact to exchange materials and energy. A number of organisms may live together in one place and regularly interact with one another to exchange materials and energy. They create a community of living things. Adjacent communities, although they may differ significantly in the organisms that compose them, also may exchange some materials and energy. Some organisms regularly move between several communities and may feed in one while taking shelter in another.

Process skills
- observing
- classifying
- inferring
- creative thinking
- interpreting data

Habits of mind
- curiosity
- reliance on data, facts & observations
- looks for connections

Environmental ethics
- environmental awareness
- environmental understanding

Disciplinary focus
- interdisciplinary

E21: **Learners can generate a list of non-traditional uses for a given object or material.**

Content/Context

One person's waste is another person's resource. Sometimes the unused products from an activity can be used to do something else (e.g. sawdust can be used for particleboard, heat from an incinerator can be used to heat a building.) Reuse and recycling of wastes as new resources reduces the demand on virgin resources and thus increases the sustainability of a given culture and population.

Process skills
- observing
- communicating
- cooperative skills

Habits of mind
- openness to new ideas

Environmental ethics
- stewardship

Disciplinary focus
- science
- geography

E22: **Learners can develop a list distinguishing basic needs from wants.**

Content/Context

Humans depend on their environment in many different ways. Sometimes they have difficulty distinguishing their needs from their wants. Humans have certain basic needs (food, shelter, clean water, space). Many of the things humans have (television sets, cars etc.) meet our wants rather than our needs. Many natural resources are finite. The more people there are, the less of the resource is available per person. Resources are not equitably distributed in the world. Some societies are better able to meet the needs and wants of its citizens than others. Some people have more resources than others even within a given society. Needs are universal. Wants differ from one culture to another.

Process skills
- classifying
- critical thinking
- analyzing
- drawing conclusions

Habits of mind
- curiosity

Environmental ethics
- environmental awareness

Disciplinary focus
- social science

E23: **Learners can identify basic natural resources that are needed to sustain human life in our society.**

Content/Context

Materials in the environment can be perceived as resources to meet human needs and desires. All animals, including humans, have certain basic needs (food, water, shelter, space). Some also require social interactions. Fresh water, limited in supply, is essential for life and also for most industrial processes. Rivers, lakes, and groundwater can be depleted or polluted, becoming unavailable or unsuitable for life. The benefits of earth's resources—such as fresh water, air, soil, trees, wildlife, and trees—can be reduced by using them wastefully or by deliberately or inadvertently destroying them.

Process skills
- observing

- classifying
- inferring
- critical thinking
- communicating
- interpreting data
- analyzing
- synthesizing
- drawing conclusions

Habits of mind

- openness to new ideas
- reliance on data, facts & observations
- looks for connections
- projects likely consequences of actions
- investigates historical development of issue

Environmental ethics

- environmental awareness
- environmental understanding
- stewardship

Disciplinary focus

- science
- social science

E24: **Learners can give examples of renewable and non-renewable resources and explain the difference between the two categories of resources.**

Content/Context

Some resources can be reused or recycled, others can not, and once used they are unavailable to future generations. Natural resources can be classified into a variety of categories. Some are readily renewed—most of these are biological in nature and have short life cycles and rapid reproduction. Some resources are technically renewable but are functionally non-renewable because of the long time span required to replace them—fossil fuels fall in this category. Resources that are permanently combined into new forms are considered non-renewable because it would take enormous quantities of energy to separate them and recombine them into new forms. Although matter can neither be created nor destroyed it can be transformed into materials that are no longer useful, and even potentially harmful to humans.

Process skills

- classifying
- inferring
- compare & contrast
- communicating
- categorizing

Habits of mind

- reliance on data, facts & observations

Environmental ethics
- environmental awareness
- environmental understanding
- stewardship

Disciplinary focus
- science
- social science

E25: **The learner will identify a school community challenge** *(e.g. recycling opportunity, careless use of water, animal or plant overpopulation, soil compaction, need for physical recreation opportunities)* **and propose a solution for that problem.**

Content/Context

Thoughtful planning and community education can counteract the effect of misuse of natural resources. Small effects (letting water fountains run, discarding garbage and paper wastes together) can create larger problems. It is easier to address problems at a local level than to have to correct environmental problems on a broader scale.

Process skills
- inferring
- predicting
- compare & contrast
- critical thinking
- creative thinking
- interpreting data
- estimating
- analyzing
- synthesizing
- drawing conclusions
- cooperative skills

Decision-making skills
- choosing among alternatives
- cooperative problem solving

Habits of mind
- curiosity
- openness to new ideas
- skepticism
- reliance on data, facts & observations
- looks for connections
- projects likely consequences of actions
- investigates historical development of issue

Environmental ethics
- environmental awareness
- environmental understanding

- stewardship

Disciplinary focus
- social science
- interdisciplinary

E26: **The learner will develop a procedure for investigating a common natural phenomenon.**

Content/Context

One of the best ways of learning about a natural phenomenon is by checking it out for oneself. This may include learning to use the library, computer networks, and available adults. The learner may also develop a procedure for checking the phenomenon out for him or herself. This entails asking appropriate questions and then determining how to obtain answers to those questions.

Process skills
- observing
- predicting
- critical thinking
- creative thinking
- communicating
- cooperative skills

Habits of mind
- curiosity
- projects likely consequences of actions

Environmental ethics
- environmental awareness

Disciplinary focus
- science

E27: **Learners can name their favorite plants, animals, and places and tell why these things are their favorites and why people should try to protect these things for others to enjoy as well.**

Content/Context

People tend to identify closely with some other living things and with special places. These things and places tend to fulfill some special emotional and spiritual needs of individuals. People tend to nurture and protect those things which have a special meaning in their lives. Regular direct contact with the natural world helps young people develop those special relationships with aspects of the natural world and stimulates their desire to see that others, now and in the future, can have similar experiences. 49

Process skills
- observing

- classifying
- compare & contrast
- communicating
- analyzing
- synthesizing

Habits of mind

- curiosity
- reliance on data, facts & observations
- looks for connections

Environmental ethics

- environmental awareness
- stewardship

Disciplinary focus

- science

Benchmarks of Environmental Literacy For Grades 5-8

Perspective

The 5-8 grouping focuses on understanding the interactive processes between people and the environment. (Environment should be understood to include the bio-physical environment and both social and mind/body environments.) *Learners explore their relationships with the world around them, discover options and limitations and learn how to deal with each. Learners develop tools for recognizing and addressing environmental issues and explore the basic citizenship skills needed for taking individual and collective action to maintain, restore, or improve environmental conditions.*

Our human ability to shape the future comes from a capacity for generating knowledge and developing new technologies -- and for communicating ideas to others. Middle level students' imaginations can be stimulated through the use of analogies, metaphors, and direct experiences as they develop from concrete to more abstract thinking.

Options

The benchmark guides that follow **do not** constitute a curriculum. They represent concepts, skills, and insights about environmental relationships that a youngster should possess by the time he or she leaves eighth grade. They are components of environmental literacy appropriate to the developmental skills and understandings of most middle level students.

There are various ways in which experiences, materials, and lessons may be organized so that students develop these understandings over the years represented by these grades. It is not in the purview of this document to recommend one approach over another. That is the proper role of the local school district. However, it should be understood that there are basically three levels of development for each benchmark—**introduction** of key concepts and

skills, **expansion** of understanding and skill, and **mastery** of both concepts and skills. Different aspects of this sequence may take place over the 5-8 grade span. It is important, however, that by the end of grade eight students should be able to demonstrate their understanding of and competency with these understandings, ideas, and skills.

Benchmark Structure

Each benchmark is stated from an outcome-based position. The overall benchmark statement includes a brief content statement and a set of items for **process skills, decision-making skills, habits of mind, and environmental ethics**. The items are ones with which a learner will need to be reasonably proficient in order to meet the benchmark performance standards .

There is no hierarchy of benchmarks—that is, no one is more or less important than another; all are important for true environmental literacy development. Numbers are assigned to each benchmark only for reference ease. All should be addressed over the middle level grade span. In many ways the benchmarks serve as an assessment tool to determine the degree to which environmental education has been successful. Students will vary considerably in their level of mastery of a benchmark but overall the class should achieve and demonstrate advancement to a nominal level of environmental literacy over the four year span.

BENCHMARKS 5-8

M1: **Learners can choose plants and animals from a list of common species and explain how they are adapted to the environments in which they live.**

Content/Context

Plants and animals are adapted to the environments in which they live. Animals and plants have a great variety of body designs and internal structures that contribute to their being able to make or find food and reproduce. Individual organisms with certain traits are more likely than others to survive and have offspring. Changes in environmental conditions can affect the survival of individual organisms and entire species. Like other animals, human beings have body systems for obtaining and providing energy, defense, reproduction, and the coordination of body functions. Characteristics of different physical environments provide for, or place constraints on, activities of different organisms.

Process skills

- critical thinking
- interpreting data
- categorizing
- analyzing
- synthesizing

Habits of mind

- reliance on data, facts & observations
- looks for connections

Environmental ethics

- environmental awareness

Disciplinary focus

- science

M2: **Learners can demonstrate knowledge of the basic concept of an ecosystem, its biological and physical components.**

Content/Context

An ecosystem is composed of living organisms and abiotic factors such as soil, air, and water. Ecosystems function to circulate matter and energy. Ecosystems contain a variety of processes like a water cycle, carbon cycle, nitrogen cycle and similar processes to accomplish the circulation of matter and energy. Food chains and webs are also present in functioning ecosystems as mechanisms for circulating both matter and energy. 60

Process skills

- inferring
- compare & contrast
- communicating

- interpreting data
- categorizing
- analyzing

Habits of mind

- openness to new ideas
- reliance on data, facts & observations
- looks for connections

Environmental ethics

- environmental awareness
- environmental understanding

Disciplinary focus

- science

M3: **Learners can identify and describe several of the interacting systems that make up their biophysical and social environments.**

Content/Context

Thinking about things as systems means looking for how every part relates to others. Output (which can include material, energy, or information) from one part of a system can become the input to other parts. Such feedback can serve to control what goes on in the system as a whole. Any system is usually connected to other systems, both internally and externally. Thus a system may be thought of as containing subsystems and as being a subsystem of a larger system. Physical and biological systems tend to change until they become stable and then remain that way unless their surroundings change. A system may stay the same because nothing is happening or because the happenings exactly counterbalance one another. Human modifications of a physical or biological system in one place often lead to changes in other systems.

Process skills

- classifying
- critical thinking
- communicating
- analyzing
- drawing conclusions

Habits of mind

- investigates historical development of issue

Environmental ethics

- environmental awareness
- environmental understanding

Disciplinary focus

- science

M4: Learners **can select a system from a listing of systems and indicate the major component parts of the system and the roles each part plays in the**

system. *(The list should include at least the following ecosystems: salt marsh/estuary; deciduous forest; inland or coastal watershed; urban ecosystem.)*

Content/Context

Objects interact with one another in a variety of ways to form systems. Systems usually perform some function that requires the interconnection of all their components. Smaller systems often are components of larger systems and make some contribution to the proper functioning of the larger system. Living organisms and non-living environmental structures interact to cycle matter and transfer energy as ecosystems. Small ecosystems, such as decaying logs, food webs, and the like, form larger ecological communities and biomes. Each component of a system plays some role in the system.

Process skills
- classifying
- compare & contrast
- critical thinking
- creative thinking
- interpreting data
- analyzing
- synthesizing

Habits of mind
- looks for connections

Environmental ethics
- environmental understanding
- stewardship

Disciplinary focus
- science

M5: **Learners can describe cyclic changes in the natural world** *(seasonal changes, life cycles, phases of the moon, water cycle, carbon/oxygen cycle)* **and compare common characteristics of identified cycles.**

Content/Context

Change is an ongoing, regular feature of the environment. Some changes are linear, but many are cyclical and predictable. The time frames of cyclical changes vary widely but the events follow a recurring and predictable pattern.

Process skills
- classifying
- compare & contrast
- critical thinking
- interpreting data
- categorizing

- analyzing

Habits of mind
- reliance on data, facts & observations
- looks for connections

Environmental ethics
- environmental awareness
- environmental understanding

Disciplinary focus
- science

M6: **Learners can distinguish between renewable and non-renewable resources and explain the difference.**

Content/Context

Some resources can be reused or recycled, others can not and once used they are unavailable to future generations. Resources can be classified into a variety of categories. Some are readily renewed—most of these are biological in nature and have short life cycles and rapid reproduction. Some resources are technically renewable but are functionally non-renewable because of the long time span required to replace them—fossil fuels fall in this category. Resources that are permanently combined into new forms are considered non-renewable because it would take enormous quantities of energy to separate them and recombine them into new forms.

Process skills
- classifying
- inferring
- compare & contrast
- creative thinking
- communicating
- categorizing
- drawing conclusions

Habits of mind
- reliance on data, facts & observations

Environmental ethics
- environmental awareness
- environmental understanding
- stewardship

Disciplinary focus
- science
- geography

M7: **Learners can cite numerous examples of how materials in the environment are used over and over again over time, both in natural and human-generated systems** (*i.e. from dead leaves to soil; recycled material to*

new products, carbon through photosynthesis and respiration in plants and animals.)

Content/Context

Materials in the environment are used again and again over time. Over a long time, matter is transferred from one organism to another repeatedly, and between organisms and their physical environment. As in all material systems, the total amount of matter remains constant, even though its form and location change.

Food provides the fuel and the building material for all organisms. Plants use the energy from light to make sugars from carbon dioxide and water. this food can be used immediately or stored for later use. Organisms that eat plants break down the plant structures to produce the materials and energy they need to survive. Then they are consumed by other organisms.

Process skills
- inferring
- predicting
- compare & contrast
- critical thinking
- communicating

Habits of mind
- reliance on data, facts & observations
- looks for connections

Environmental ethics
- environmental awareness
- environmental understanding

Disciplinary focus
- science

M8: **Learners can differentiate and explain the difference between a waste and a resource and give concrete examples of each.**

Content/Context

Wastes are materials that cannot be used in a positive manner by an organism or system in meeting its basic needs; resources are materials that an organism or system can use to meet its needs or wants. Wastes from one organism or system may prove to be resources for another organism or system. Household wastes may prove to be resources for some industries, food wastes for humans may be food resources to insects, molds, and other such organisms. Ecosystems usually have developed ways to use the wastes of one component as the resources for another component. Economic systems are being developed to do what ecosystems do in using wastes as resources.

Process skills
- observing

- classifying
- compare & contrast
- critical thinking
- categorizing
- analyzing
- synthesizing

Habits of mind

- openness to new ideas
- skepticism
- looks for connections

Environmental ethics

- environmental awareness
- environmental understanding
- stewardship

Disciplinary focus

- science
- geography

M9: **Learners can state examples of materials in the environment that are perceived as resources to meet human needs and desires. They can give examples of items that are perceived as resources in our culture but not in some others.**

Content/Context

Materials in the environment can be perceived as resources to meet human needs and desires. Fresh water, limited in supply, is essential for life and also for most industrial processes. Rivers, lakes, and groundwater can be depleted or polluted, becoming unavailable or unsuitable for life. The benefits of Earth's resources—such as fresh water, air, soil, wildlife, and trees—can be reduced by using them wastefully or by deliberately or inadvertently destroying them. Different cultures perceive different components of the environment to be resources or put different degrees of value on a particular resource. The wastes of a culture can also be perceived to be a type of resource.

Process skills

- observing
- classifying
- inferring
- critical thinking
- creative thinking
- communicating
- interpreting data
- categorizing
- analyzing
- synthesizing
- drawing conclusions

Habits of mind
- openness to new ideas
- reliance on data, facts & observations
- looks for connections
- projects likely consequences of actions
- investigates historical development of issue

Environmental ethics
- stewardship
- "green" consumerism

Disciplinary focus
- science
- geography

M10: **Learners can describe an environmental change** *(i.e. soil erosion, air quality degradation, species extinction)* **and give a consequence of that change.**

Content/Context

Change is the most constant thing in the universe; changes are always underway at varying rates. Some changes occur very rapidly (i.e. explosions); others take place very slowly over vast periods of time (i.e. development of rock layers or cooling of stars). There is some consequence for every change. Decaying leaves are broken down into their simplest components which can be reused to create new leaves; eroded topsoil is deposited somewhere else but what remains behind is less productive of living things; as species become extinct the ecosystems of which they were a member become less stable, and so forth. Not all consequences are negative. The consequences of some changes are quite positive for some factors but may well be negative for others.

Process skills
- inferring
- predicting
- compare & contrast
- critical thinking
- communicating
- estimating
- categorizing
- analyzing
- synthesizing

Habits of mind
- reliance on data, facts & observations
- looks for connections
- projects likely consequences of actions
- investigates historical development of issue

Environmental ethics
- environmental awareness

- environmental understanding

Disciplinary focus
- science
- interdisciplinary

M11: **Learners can describe the possible affects on the survival of individual organisms and entire species brought on by changes in environmental conditions.**

Content/Context

Changes in environmental conditions can affect the survival of individual organisms and entire species. The cycling of water in and out of the atmosphere plays an important role in determining climatic patterns. Climate affects physical limitations on the diversity of living things in a region. Human populations, like all animal populations, rise and fall according to basic principles affecting birth, death, and emigrations. Changes in human population levels and their concentration have a variety of impacts on local, regional, and global environments. Pollutants released into the environment affect living things in a variety of ways—some positive, some negative depending on the species.

Process skills
- inferring
- predicting
- critical thinking
- creative thinking
- communicating
- analyzing
- synthesizing

Habits of mind
- openness to new ideas
- skepticism
- reliance on data, facts & observations
- looks for connections
- projects likely consequences of actions

Environmental ethics
- stewardship

Disciplinary focus
- science

M12: **Learners can explain the effect of births, deaths, and emigrations on human populations and can cite examples of both positive and negative consequences of changes in regional populations.**

Content/Context

Human populations, like all animal populations, rise and fall according to basic principles affecting birth, death, and emigrations. Changes in human population levels and their concentrations have a variety of impacts on local, regional, and global environments. Geographic and political barriers can impede the flow of people, goods, and ideas, but human ingenuity often finds creative ways to overcome the barriers. These ways often have negative environmental impacts. Conflict and cooperation among people contribute to economic and social divisions of Earth's surface.

Process skills
- inferring
- predicting
- compare & contrast
- critical thinking
- communicating
- interpreting data
- synthesizing
- drawing conclusions

Habits of mind
- skepticism
- looks for connections
- projects likely consequences of actions
- investigates historical development of issue

Environmental ethics
- environmental awareness
- environmental understanding

Disciplinary focus
- social science

M13: **Given common examples of change** *(food to bodily activity, water to steam, photosynthesis)* **learners can explain the ways in which the form and transformation of energy drives the changes.**

Content/Context

Energy is what drives change. Most of what goes on in the universe—from exploding stars and biological growth to the operation of machines and the motion of people—involves some form of energy being transformed into another. Energy appears in different forms—heat, chemical, mechanical, electrical, nuclear. Energy can change from one form to another in living things. Animals get energy from oxidizing their food, releasing some of its energy as heat. Almost all food energy comes originally from sunlight. Heat energy carried by the ocean and atmospheric currents has a strong influence on climate around the world.

Process skills
- inferring

- predicting
- critical thinking
- creative thinking
- communicating
- analyzing
- synthesizing
- drawing conclusions

Habits of mind

- curiosity
- looks for connections
- projects likely consequences of actions

Environmental ethics

- environmental awareness
- environmental understanding

Disciplinary focus
- science

M14: **Provided with several objects or organisms and the appropriate key(s), the learner will identify the organisms or objects.**

Content/Context

Our world is generally perceived as being made up of discrete objects both living and non-living. These objects have many interactions and interconnections with one another. Humans tend to create a series of categories in which to place the variety of discrete objects. These categories all have criteria which we learn so that there can be general agreement about where to place the objects. Different cultures may categorize the same objects in different ways. Scientists have created devices, called keys, that contain the basic criteria. When used properly, a person can use observations of the object to match with the criteria in the key to arrive at an identification of the desired object.

Process skills

- observing
- classifying
- compare & contrast
- critical thinking
- categorizing

Habits of mind

- openness to new ideas
- skepticism
- reliance on data, facts & observations

Environmental ethics

- environmental awareness

Disciplinary focus
- science

M15: **Learners can cite examples of how to manage a system by changing its variables.**

Content/Context

Technologies having to do with food production, sanitation, and disease prevention have dramatically changed how people live and work and have resulted in rapid increases in the human population. Changes in technology, transportation, and communication affect the location of economic activities.

Students might note how different types of vehicles and conveyances and the kinds of routes each requires affects land use and transport time; or they might discuss how carrier pigeons, pony express, telegraph, telephone, regular mail, e-mail and television affect the nature of communication and the basic resources required for each. They could then demonstrate how to change the system involved by changing one or more of the variables, i.e. the components of the system.

Process skills

- critical thinking
- creative thinking
- interpreting data
- categorizing
- analyzing
- drawing conclusions

Habits of mind

- reliance on data, facts & observations

Environmental ethics

- environmental awareness
- environmental understanding

Disciplinary focus

- science
- interdisciplinary

M16: **The learner will choose and use appropriate technologies** *(thermometers, soil augers, computers, photography)* **to gather and record observations regarding a complex system** *(e.g. the atmosphere or an ecosystem)* **and use the observations to make predictions about the effects of changes made in various components of that system.**

Content/Context

As the complexity of any system increases, gaining an understanding of it depends increasingly on summaries, such as averages and ranges, and on descriptions of typical examples of that system. Technology is essential for

such purposes as access to remote locations, sample collection and treatment, measurement, data collection and storage, computations, and communication of information. The side effects of technologies may turn out to be unacceptable to some people and therefore lead to conflict between groups. There are trade-offs that each person must consider in making choices that often have life-long consequences. All these factors must be taken into account when making predictions about how a system will behave when changed.

Process skills
- observing
- inferring
- predicting
- critical thinking
- interpreting data
- analyzing
- synthesizing

Habits of mind
- curiosity
- openness to new ideas
- skepticism
- reliance on data, facts & observations
- projects likely consequences of actions

Environmental ethics
- environmental understanding

Disciplinary focus
- science and mathematics

M17: **Learners can give examples of how the organization of systems** *(physical systems, biological systems, social systems)* **becomes more and more disorganized if energy is not regularly invested to maintain the basic functional organization.**

Content/Context

It takes regular energy input to maintain the organization of any system. This reflects the basic laws of entropy. The amount of time it takes for a system to become disorganized without energy inputs varies widely with the nature of the system. Buildings and bridges will decay, closets and drawers will become chaotic, bodies will lose weight and tone, and many other effects become apparent when a system is left poorly attended and energy is not invested in keeping the system at peak efficiency. There are limits to how much energy anyone or anything has available to invest in a variety of subsets of any system. Any system is subject to disintegration over time when regular input of energy is unavailable. This is as true of social systems and bio-physical systems.

Process skills
- observing
- inferring
- predicting
- compare & contrast
- critical thinking
- estimating
- analyzing
- synthesizing

Decision-making skills
- formulating operational definitions
- generating relevant questions
- gathering verifiable information
- projecting consequences of each alternative

Habits of mind
- curiosity
- openness to new ideas
- reliance on data, facts & observations
- projects likely consequences of actions
- investigates historical development of issue

Environmental ethics
- environmental awareness
- environmental understanding

Disciplinary focus
- science
- interdisciplinary

M18: **Learners can identify patterns of change in the natural and technological world as trends** *(i.e. more development leads to* **reduced forest habitat), cycles (changes of state in water gives us the water cycle), or chaos** *(uncontrolled urban migration).*

Content/Context

Scientists' explanations about what happens in the world come partly from what they observe, partly from what they think. Sometimes scientists have different explanations for the same set of observations. That usually leads to the scientists making more observations to resolve the differences. Mathematics is the study of many kinds of patterns, including numbers and shapes and operations on them. Sometimes patterns are studied because they help explain how the world works or how to solve practical problems, sometimes because they are interesting in themselves. Events can be described in terms of being more or less likely, impossible, or of very high probability.

Process skills
- inferring

- predicting
- compare & contrast
- critical thinking
- creative thinking
- interpreting data
- estimating

Habits of mind

- reliance on data, facts & observations
- looks for connections
- projects likely consequences of actions
- investigates historical development of issue

Environmental ethics

- stewardship

Disciplinary focus

- science and mathematics
- social studies

M19: **Presented with data on the consumption pattern of a resource in the local community, the learner will propose** *(e.g. written proposal, persuasive materials, videos)* **a strategy to manage the resource more efficiently and economically.**

Content/Context

Human activities, such as reducing the amount of forest cover, increasing the amount and variety of chemicals released into the atmosphere, and intensive farming, have changed the Earth's land, oceans, and atmosphere. Some of these changes have decreased the capacity of the environment to support some life forms.

The benefits of the Earth's resources - such as fresh water, air, soil, and trees - can be reduced by using them wastefully or by deliberately or inadvertently destroying them. The atmosphere and the oceans have a limited capacity to absorb wastes and recycle materials naturally. Cleaning up polluted air, water, or soil or restoring depleted soil, forests, or fishing grounds can be very difficult and costly.

Process skills

- predicting
- measuring
- compare & contrast
- critical thinking
- creative thinking
- communicating
- interpreting data
- analyzing
- synthesizing

- drawing conclusions

Decision-making skills
- suggesting potential alternative solutions
- projecting consequences of each alternative
- choosing among alternatives

Habits of mind
- openness to new ideas
- skepticism
- reliance on data, facts & observations
- looks for connections
- projects likely consequences of actions
- investigates historical development of issue

Environmental ethics
- environmental awareness
- environmental understanding
- stewardship

Disciplinary focus
- social studies

M20: **Learners can explain ways in which humans impact the environment and cite multiple examples of technologies** *(i.e.chemical manufacture, heavy construction equipment, mechanical transportation, etc.)* **that extend human abilities to alter the environment.**

Content/Context

Technology extends the ability of people to change the world: to cut, shape, or put together materials; to move things from one place to another; and to reach farther with their hands, voices, senses, and minds. The changes may be for survival needs such as food, shelter, and defense, for communication and transportation, or to gain knowledge and express ideas. Engineers, architects, and others who engage in design and technology use scientific knowledge to solve practical problems. Design usually requires taking constraints into account. Some constraints, such as gravity or the properties of the materials to be used, are unavoidable. Other constraints, including economic, political, social, ethical, and aesthetic ones, limit choices.

Process skills
- inferring
- predicting
- compare & contrast
- critical thinking
- creative thinking
- communicating
- estimating
- analyzing
- synthesizing

- drawing conclusions
- cooperative skills

Habits of mind

- skepticism
- reliance on data, facts & observations
- looks for connections
- projects likely consequences of actions
- investigates historical development of issue

Environmental ethics

- stewardship
- voluntary simplicity
- "green" consumerism

Disciplinary focus

- science
- social studies

M21: **Learners can compare the rate of resource consumption per capita between the United States and at least one third world nation and give examples of the potential consequences of each country's rate of resource consumption to the global environment over the next few generations.**

Content/Context

Natural resources are not equally distributed around the Earth. The citizens of the United States consume more resources per capita than the citizens of any other nation. Many of the resources used in the United States come from other parts of the globe. The United States has become a net importer of resources, particularly of energy resources. This has become an issue of global environmental equity. It is suggested by many leaders that each country's economies need to be developed or adjusted in ways that make them sustainable over long periods of time if humans are to have a long history on this planet. This implies that Americans, in particular, will need to adjust their consumption habits.

Process skills

- inferring
- predicting
- compare & contrast
- critical thinking
- creative thinking
- categorizing
- analyzing
- synthesizing
- drawing conclusions
- cooperative skills
- cooperative problem solving

Habits of mind

- openness to new ideas
- skepticism
- reliance on data, facts & observations
- looks for connections
- projects likely consequences of actions
- investigates historical development of issue

Environmental ethics

- environmental awareness
- environmental understanding
- stewardship
- voluntary simplicity
- "green" consumerism

Disciplinary focus

- social studies

M22: **Given examples of common choices people can make regarding the use of everyday technologies** *(choosing natural vs synthetic fibers for clothes, bicycles vs cars, computers vs pencil and paper)*, **learners can project likely consequences of the alternative actions.**

Content/Context

All technologies have effects other than those intended by the design, some of which may have been predictable and some not. In either case, these side effects may turn out to be unacceptable to some of the population and therefore lead to conflict between groups. Individuals can make choices among technologies to minimize impacts on the environment.

Process skills

- observing
- inferring
- predicting
- compare & contrast
- critical thinking
- interpreting data
- estimating
- categorizing
- analyzing
- synthesizing
- drawing conclusions

Decision-making skills

- generating relevant questions
- gathering verifiable information
- projecting consequences of each alternative

Habits of mind

- skepticism
- reliance on data, facts & observations

- looks for connections
- projects likely consequences of actions

Environmental ethics

- stewardship
- voluntary simplicity
- "green" consumerism

Disciplinary focus

- interdisciplinary

M23: **The learner will identify a community environmental problem** *(e.g. recycling, loss of water quality, animal and plant overpopulation and competition, extinction of species, unregulated urban growth, soil depletion or erosion, transportation issues, loss of physical recreation opportunities)* **and propose a solution for that problem using information collected to support his or her proposal.**

Content/Context

Each environmental system's components contribute to the healthy functioning of the respective ecosystem; environmental problems occur when something interferes with, or disrupts, the functioning of one or more components of the system. Effective solution of environmental problems involves determining which parts of the system are dysfunctional and determining potential ways of restoring the component to its proper role or replacing it with a fully functional new component.

Process skills

- inferring
- predicting
- compare & contrast
- critical thinking
- creative thinking
- interpreting data
- estimating
- analyzing
- synthesizing
- drawing conclusions

Decision-making skills

- generating relevant questions
- gathering verifiable information
- suggesting potential alternative solutions
- projecting consequences of each alternative
- choosing among alternatives

Habits of mind

- curiosity
- openness to new ideas
- skepticism

- reliance on data, facts & observations
- looks for connections
- projects likely consequences of actions
- investigates historical development of issue

Environmental ethics

- environmental awareness
- environmental understanding
- stewardship

Disciplinary focus

- science and mathematics
- social studies

M24: **Given a product** *(a snack food, clothing material, cleaning product, etc.)* **learners can locate sources of information through which they can evaluate and determine the general impact of that product on their health and the health of the environment.**

Content/Context

Every product has advantages and drawbacks for particular individuals and the overall health of the environment. Consumers need to be able to evaluate these benefits and drawbacks in making purchasing choices. Government agencies often are charged with generating some of this information and business and industry consortia also generate some of this information. Active citizens know how to access the information and make critical choices based on their own values and concerns. Advertising tends to emphasize the advantages and ignore the drawbacks. Consumer organizations are more likely to draw attention to the drawbacks. The citizen needs to develop the skills to access and evaluate both the advantages and drawbacks for individuals and their potential consequences for the environment.

Process skills

- observing
- inferring
- predicting
- compare & contrast
- critical thinking
- interpreting data
- estimating
- categorizing
- analyzing
- synthesizing
- drawing conclusions

Decision-making skills

- generating relevant questions
- gathering verifiable information

- projecting consequences of each alternative

Habits of mind
- curiosity
- openness to new ideas
- skepticism
- reliance on data, facts & observations
- looks for connections
- projects likely consequences of actions

Environmental ethics
- environmental awareness
- environmental understanding
- "green" consumerism

Disciplinary focus
- science and mathematics
- social studies

M25: **Given a local environmental issue of their choosing, learners can create a listing of the expected economic, social, and ecological costs and benefits of alternative proposals for resolving the issue.**

Content/Context

Every environmental action has it costs and benefits. These costs and benefits fall into three major categories—economic, social, and ecological. Making action choices on any environmental issue involves weighing and balancing the costs and benefits of all the proposed solutions of each issue. Choices also often require making considered tradeoffs between various costs and benefits among the three major categories.

Process skills
- classifying
- inferring
- predicting
- measuring
- compare & contrast
- communicating
- interpreting data
- estimating
- categorizing
- analyzing
- synthesizing

Habits of mind
- openness to new ideas
- skepticism
- reliance on data, facts & observations
- projects likely consequences of actions

Environmental ethics
- environmental understanding
- stewardship
- "green" consumerism

Disciplinary focus
- science and mathematics
- social studies

M26: **Given the observations of several witnesses to an environmental event or issue, along with related evidence, the learner can distinguish the various perspectives presented and their influence on general explanations of the event or environmental issue.**

Content/Context

Two individuals seldom see the same event in the same way; their observations are colored by their prior experiences and value systems. In examining statements about different viewpoints around an environmental issue it is important to know something about the background of the individual players and what experiences and values systems color their observations and comments regarding the issue.

Process skills
- classifying
- inferring
- compare & contrast
- critical thinking
- analyzing
- drawing conclusions

Habits of mind
- skepticism
- reliance on data, facts & observations

Environmental ethics
- environmental awareness
- environmental understanding

Disciplinary focus
- social studies

M27: **Given a learner-identified issue of local community importance** *(e.g. air pollution, pesticides, chemical exposure, radon, abandoned hazardous waste sites, high-voltage transmission lines, landfills, lawn management)*, **the learner will collect information and observations and take action on a decision made regarding the issue.**

Content/Context

To hone problem-solving skills, students need experiences which offer them opportunities to: recognize, identify, and state a problem; collect,

organize, and analyze information; generate alternative solutions; consider the consequences (economic, social, environmental, and emotional) of different alternative solutions on individuals and groups; clarify personal values; build a consensus;negotiate, persuade, and commit; evaluate and select an alternative; develop a plan of action and act upon it; and evaluate the process.

Process skills
- observing
- inferring
- predicting
- measuring
- compare & contrast
- critical thinking
- creative thinking
- communicating
- interpreting data
- categorizing
- analyzing
- synthesizing
- drawing conclusions
- cooperative skills

Decision-making skills
- formulating operational definitions
- generating relevant questions
- gathering verifiable information
- suggesting potential alternative solutions
- projecting consequences of each alternative
- choosing among alternatives
- acting on choice
- cooperative problem solving

Habits of mind
- curiosity
- openness to new ideas
- skepticism
- reliance on data, facts & observations
- looks for connections
- projects likely consequences of actions
- investigates historical development of issue

Environmental ethics
- environmental awareness
- environmental understanding
- stewardship

Disciplinary focus
- science and mathematics
- social studies

M28: **The learner will construct, test, and trouble-shoot a set of procedures for younger learners to use for investigating a common natural phenomenon.**

Content/Context

People sharpen their own perceptions of their world when they set about explaining their understandings to others. Two people seldom see the same event in exactly the same way and they may find different meaning from similar observations of the same event. Understanding this fact can lead to broader tolerance and mutual understanding.

Process skills
- observing
- predicting
- critical thinking
- creative thinking
- communicating
- cooperative skills

Habits of mind
- curiosity
- projects likely consequences of actions

Environmental ethics
- environmental awareness

Disciplinary focus
- interdisciplinary

M29: **Learners can examine their local, regional, or global surroundings and indicate examples of inequities of access to resources, sitings of pollution cleanup facilities, distribution of resources, or other environmental inequities. They can also suggest ways in which these situations could be made more equitable for all.**

Content/Context

Resources are unevenly distributed around the planet. Pollution is more concentrated in some places than others. Thus access to specific resources and impact of the consequences of pollution on the health of specific groups is frequently inequitable. Democratic societies strive for as equitable a distribution of opportunities and burdens among their population as possible. Achievement of that goal demands widespread awareness of the inequities and a developing commitment to rectify the inequities through technological, sociological, or political means.

Process skills
- classifying
- inferring
- predicting

- compare & contrast
- critical thinking
- creative thinking
- interpreting data
- estimating
- categorizing
- analyzing
- synthesizing
- drawing conclusions
- cooperative skills

Decision-making skills

- formulating operational definitions
- generating relevant questions
- gathering verifiable information
- suggesting potential alternative solutions
- projecting consequences of each alternative
- choosing among alternatives

Habits of mind

- curiosity
- openness to new ideas
- skepticism
- reliance on data, facts & observations
- looks for connections
- projects likely consequences of actions
- investigates historical development of issue

Environmental ethics

- stewardship

Disciplinary focus

- social studies

M30: **Learners can give concrete local and global examples to explain the concept that "Environmental quality is the net sum of the consequences of individual and group actions."**

Content/Context

Every action has consequences for the environment. Some of these are positive; some are negative consequences. The quality of the environment at any point in time is the net sum—the positives minus the negatives— of all the actions. Students may indicate, for example, that 40% of the people in town are still not recycling. This means that overall environmental quality has improved but there is still considerable room for improvement. Similar observations on regional and global levels can be made for a variety of indicators of overall environmental quality.

Process skills

- inferring
- predicting

- compare & contrast
- critical thinking
- creative thinking
- communicating
- interpreting data
- estimating
- analyzing
- synthesizing
- drawing conclusions

Decision-making skills

- formulating operational definitions
- generating relevant questions
- gathering verifiable information
- suggesting potential alternative solutions
- projecting consequences of each alternative

Habits of mind

- curiosity
- openness to new ideas
- skepticism
- reliance on data, facts & observations
- looks for connections
- projects likely consequences of actions
- investigates historical development of issue

Environmental ethics

- environmental understanding

Disciplinary focus

- interdisciplinary

Benchmarks for Environmental Literacy for Grades 9-12

Perspectives

The 9-12 grouping of environmental literacy benchmarks focuses on developing depth of understanding about the ecological relationships between human activity and the environment and in honing the skills needed to make decisions and take actions to maintain, restore, or improve environmental conditions. Environment should be understood to include the bio-physical environment and both social and mind/body environments. *In terms of Massachusetts testing procedures, it is assumed that much of the knowledge component will be in place by the end of grade 10 and that opportunities to put the knowledge to practice through case study explorations and community action projects will be provided during grades 11 and 12.*

The benchmarks and content statements below do not constitute a curriculum or course of study, instead they represent the framework of information about ecology, environmental perspectives, relationships, and interactions that a student should know by the time he or she leaves the 12th grade. The concepts and skills outlined may be included in any of several traditional high school subjects including not only sciences but literature, history, government, and geography as well. The concepts and processes are the major components of environmental literacy appropriate to the developmental level of most twelfth grade students.

Options

Students may acquire these skills and understandings through infusion in standard discipline-focused courses, special courses, or other curriculum designs. The essential thing is that students be given the exposure to the key concepts and skills and be given opportunities to put their accumulated knowledge to work through involvement in some real environmental issues. In order to truly attain a functional level of environmental literacy,

students need to have some "real world" involvement in addressing such issues.

Benchmark Structure

Each benchmark is stated from an outcome-based position. The overall benchmark statement includes a brief content statement and a set of items for **process skills, decision-making skills, habits of mind, and environmental ethics**. The items are ones with which a learner will need to be reasonably proficient in order to meet the benchmark performance standards .

There is no hierarchy of benchmarks—that is, no one is more or less important than another; all are important for true environmental literacy development. Numbers are assigned to each benchmark only for reference ease. All should be addressed over the secondary grade span. In many ways the benchmarks serve as an assessment tool to determine the degree to which environmental education has been successful. Students will vary considerably in their level of mastery of a benchmark but overall the class should achieve and demonstrate advancement to a nominal level of environmental literacy over the four year span.

BENCHMARKS 9-12

SCIENCE CENTERED

S1: **The learner will identify and explain the major layers of Earth's overall ecosystem** *(atmosphere, lithosphere, hydrosphere, biosphere)* **and how each plays a role in the maintenance and survival of living things.**

Content/Context

It is primarily in the narrow zone at the surface of the planet where rock, air, and water mix and interact that living things exist and contribute to the current nature of each of these major zones. Air and water weather and erode the rock creating the basis of soils; living things use and alter the percentages of gases in the air; water as vapor becomes part of the air and precipitates from the air to seep into the rocks, soils and lake and ocean basins. All these factors create niches of living things. Through feedback loops in these interacting systems the peculiar features of this planet have evolved and are relatively self-maintaining.

Process skills
- inferring
- critical thinking
- communicating
- analyzing
- synthesizing

Habits of mind
- reliance on data, facts & observations
- looks for connections

Environmental ethics
- environmental understanding

Disciplinary focus
- science

S2: **Learners can describe the key features of the major kinds of terrestrial biomes of the planet** *(taiga, boreal forest, temperate deciduous forest, rain forest, grasslands, and desert)* **and can roughly plot the locations of these biomes on a world map.**

Content/Context

Broad vegetation types develop in response to geographic features of the planet. Vegetation types therefore are key descriptors of the major biomes found on earth. Either the ecological features or the topographic features can be used to map out the major biomes. The biomes are the key environmental features to which human societies must adapt for their survival. The biomes

establish certain biophysical limitations within which humans must adjust through technology, culture, and/or trade.

Process skills
- observing
- classifying
- inferring
- predicting
- compare & contrast
- critical thinking
- analyzing
- synthesizing
- drawing conclusions

Habits of mind
- reliance on data, facts & observations
- looks for connections

Environmental ethics
- environmental awareness
- environmental understanding

Disciplinary focus
- science
- geography

S3: **Learners will distinguish and explain the differences among various kinds of soils** *(type, origin, structural features)* **and explain the capacity of different soils for human use and survival of all living things.**

Content/Context

Soils are a mixture of weathered rock, organic materials, air and water. Rock particle size, slope, and type of organic matter create different types of soils with differing capacities to support living things or different kinds of human engineered structures. People need to be aware of different soil capacities in making specific choices about sites for land use, development, and construction.

Process skills
- observing
- classifying
- inferring
- predicting
- compare & contrast
- critical thinking
- interpreting data
- categorizing

Habits of mind
- reliance on data, facts & observations

- projects likely consequences of actions

Environmental ethics

- environmental awareness
- environmental understandings
- stewardship

Disciplinary focus
- science
- geography

S4: **Learners can identify and explain the importance of the major aquatic biomes of Earth** *(deep ocean, coastal ocean, estuarine, riverine systems, lakes, ponds, swamps and bogs)* **and locate them on a world map** *(also local, state, or regional maps).*

Content/Context

Water is a key material for life on Earth. Water affects the nature of terrestrial biomes and also creates a variety of biomes in its own right. These aquatic biomes are intimately linked with terrestrial biomes and exchange materials and organisms in complex ways. Aquatic biomes are strongly affected by abiotic conditions of temperature, salinity, currents and upwellings, depth, and topographical features.

Process skills

- observing
- classifying
- inferring
- predicting
- compare & contrast
- critical thinking
- analyzing
- synthesizing

Habits of mind

- reliance on data, facts & observations
- looks for connections

Environmental ethics

- environmental awareness
- environmental understanding

Disciplinary focus
- science
- geography

S5: **Given any of a range of habitats** *(lawn, garden, forest, field, stream, etc.)* **students will be able to sketch out the major biogeochemical cycles** *(carbon, water, nitrogen, phosphorus, etc.)* **that affect that habitat and explain their role in the health and survival of living organisms in that habitat.**

Content/Context

In analyzing any environment, people should be able to understand the nutrient cycles operating in them and be able to determine which of these systems are healthy and which are not. The health and well-being of the Earth's ecosystems is dependent on energy flow, resource cycling, climatic variations, and the interaction between sub-systems, organisms and habitats. The complex interactions maintain life support systems. Simplification of any of them erodes the ability of the overall system.

Process skills

- observing
- inferring
- predicting
- compare & contrast
- critical thinking
- communicating
- interpreting data
- analyzing
- synthesizing
- drawing conclusions

Habits of mind

- openness to new ideas
- reliance on data, facts & observations
- looks for connections

Environmental ethics

- environmental awareness
- environmental understanding
- stewardship

Disciplinary focus

- science

S6: **Learners can explain through concrete examples how the processes of photosynthesis and respiration work in concert to allow the continuation of life on earth.**

Content/Context

The process of photosynthesis allows capture and retention of solar energy in organic molecules while the process of respiration allows the release of that retained energy in ways that let organisms use the energy for growth, repair, activity, and reproduction. If plants were unable to photosynthesize, most animals would have not have access to needed energy and complex ecosystems would collapse.

Process skills

- inferring
- predicting

- compare & contrast
- critical thinking
- communicating
- analyzing
- synthesizing

Habits of mind

- openness to new ideas
- skepticism
- reliance on data, facts & observations
- looks for connections

Environmental ethics

- environmental awareness
- environmental understanding

Disciplinary focus

- science

S7: **Learners can explain the causes and consequences of exponential growth on a variety of living things *(yeast, fruit flies, bacteria, humans).***

Content/Context

Abundant resources and low mortality rates stimulate exponential growth in populations of organisms. As numbers increase, available resources decline and mortality rates begin to increase; habitats become polluted and individual living space declines thereby increasing stress. Examples of this can be observed in pond eutrophication and third world population expansion. Globally, human populations are growing exponentially and impacting existing and future resources (water, soil, food, wildlife), reducing biodiversity, and widening the economic gap between the rich and the poor. The impacts of exponential growth not only threaten ecosystems but increasingly threaten human political and economic systems.

Process skills

- observing
- inferring
- predicting
- measuring
- compare & contrast
- critical thinking
- communicating
- interpreting data
- estimating
- analyzing
- synthesizing
- drawing conclusions

Decision-making skills

- suggesting potential alternative solutions

- projecting consequences of each alternative

Habits of mind

- skepticism
- reliance on data, facts & observations
- looks for connections
- projects likely consequences of actions
- investigates historical development of issue

Environmental ethics

- environmental awareness
- environmental understanding

Disciplinary focus

- science and mathematics

S8: **Using examples from their local communities, learners can demonstrate through drawings and/or photographs how communities and ecosystems change through succession. They can identify various stages of succession, identify a number of ecological niches in each stage, indicate key food chains and webs for each stage, and indicate the ways nutrient cycling is involved in the transitions from one successional stage to another. Learners can predict the likely successional pattern if the current successional stage is destroyed.**

Content/Context

Plant and animal communities interact with each other and the abiotic environment in ways that gradually modify the make-up of the communities, leading one set of organisms to gradually replace another set. This succession of one biotic community by another alters the resources of any particular environment. In general, as ecosystems move from earlier to later stages of succession they have greater diversity, are more stable, and are able to withstand stress and changes more effectively. Mature successional stages within a particular biome are usually self-renewing and able to maintain themselves for relatively long periods. Humans tend to try to keep ecosystems at secondary stages of succession thus requiring more or less constant management.

Process skills

- observing
- classifying
- inferring
- predicting
- measuring
- compare & contrast
- critical thinking
- communicating
- interpreting data
- analyzing
- synthesizing

- drawing conclusions
- cooperative skills

Habits of mind

- reliance on data, facts & observations
- looks for connections
- projects likely consequences of actions
- investigates historical development of issue

Environmental ethics

- environmental awareness
- environmental understanding

Disciplinary focus

- science and mathematics

S9: **Learners can explain how both continental and local air flow patterns can influence distribution of airborne pollutants. They can predict where local air pollutants are likely to spread due to major weather patterns, whether the source of the pollution is hundreds of miles away or local. They can recognize the conditions that will lead to temperature inversions that put many people at high risk of respiratory illness , cancers, and other bodily stresses. Learners also can site some of the consequences of air pollution for organisms and structures.**

Content/Context

Global air circulation patterns, jet stream variants, and local topographical situations affect the distribution of gases and particulates in the air. Circulation patterns of air masses move air and its contaminants from one part of the globe to another. Contaminants in the air can produce allergic reactions among humans and bring on respiratory illnesses and some cancers. Sources of contaminants may be located hundreds or thousands of miles from those people affected. Temperature inversions, local phenomena, may keep local contaminants from dispersing normally and lead to buildup of harmful contaminants in local areas for many days.

Process skills

- observing
- predicting
- measuring
- compare & contrast
- critical thinking
- communicating
- interpreting data
- analyzing
- synthesizing
- drawing conclusions

Habits of mind

- skepticism

- reliance on data, facts & observations
- looks for connections
- projects likely consequences of actions
- investigates historical development of issue

Environmental ethics

- environmental awareness
- environmental understanding

Disciplinary focus
- science and mathematics
- geography

S10: **Given one or more types of ecosystem, learners can construct a flow chart of energy through the system using their understanding of food chains, webs, and pyramids of numbers and biomass.**

Content/Context

Energy flows from the sun to Earth's ecosystems where it is passed along through food chains and webs. As the energy is changed in passage through the food webs, some is passed on through the change and some is lost to the systems as heat. This limits the length of food chains and creates the notion of pyramids of numbers and biomass.

Process skills

- observing
- classifying
- predicting
- measuring
- compare & contrast
- critical thinking
- communicating
- interpreting data
- estimating
- analyzing
- synthesizing

Habits of mind

- curiosity
- reliance on data, facts & observations
- looks for connections
- projects likely consequences of actions

Environmental ethics

- environmental awareness
- environmental understanding

Disciplinary focus
- science and mathematics

S11: **Learners can trace the energy flow within an ecosystem and demonstrate knowledge of the roles of producers, consumers, and decomposers in ecosystems.**

Content/Context

Energy flows through the food chains and webs of an ecosystem and through the circulation currents of air and water. Each time energy changes form, some of it is degraded to less useful forms such as heat. Some organisms are able to "trap" solar energy for their biological uses. These are the producers. Others get their energy by eating the producers. These are the consumers. Decomposers use energy to break down complex chemicals and molecules to simpler ones they can use and release some of these molecules for use by others to build new complex molecules. Both of these processes require energy. Energy flows through a system until it is used or degraded to a level that no longer is usable by living things.

Process skills

- inferring
- predicting
- critical thinking
- creative thinking
- communicating
- interpreting data
- analyzing
- synthesizing

Habits of mind

- reliance on data, facts & observations
- looks for connections

Environmental ethics

- environmental awareness
- environmental understanding

Disciplinary focus

- science

S12: **Learners can describe the major ecosystems that exist in the watershed** *(drainage basin)* **in which their community is located. They can indicate the major stress factors that are most likely impacting those ecosystems, explain how people have simplified many of the ecosystems leaving them more susceptible to stress and disease, and how people have acted to enhance the stability and adaptability of some of those ecosystems.**

Content/Context

Ecosystems are dynamic and are constantly being subjected to various stress conditions ranging from weather and climate changes to population irruptions of organisms within the ecosystem or introductions of species from other regions. In general, the more gradual the change within systems

and the more diverse the life forms of the system the greater the opportunity for the system to withstand the stress. As humans take over an ecosystem they have a tendency to reduce biodiversity in the system making the ecosystem more vulnerable to a variety of stresses and reducing its capacity to cycle materials and keep energy flowing. Ecosystems that have been severely reduced in biodiversity require intensive management to maintain their most basic functions. Where such management is absent, ecological collapse can occur.

Process skills

- observing
- classifying
- inferring
- predicting
- compare & contrast
- critical thinking
- creative thinking
- communicating
- interpreting data
- analyzing
- synthesizing

Habits of mind

- reliance on data, facts & observations
- looks for connections
- projects likely consequences of actions
- investigates historical development of issue

Environmental ethics

- environmental awareness
- environmental understanding

Disciplinary focus

- science
- geography

S13: **Learners can explain how natural recycling occurs with the decay of logs, leaves, and other organic material in a forest and can indicate how recycling of "waste" materials of our consumer society is as essential to sustainability of our society as recycling of logs and leaves is to sustainability of a forest ecosystem.**

Content/Context

Natural systems have long term sustainability in large measure because of adaptations that allow for use and reuse of basic matter. Human cultural systems, such as industrial and consumer societies, in large measure lack sustainability because they have not developed comparable feedback mechanisms that use and reuse the basic materials of that system. Reuse and recycling strategies increase the potential sustainability of

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consumer/industrial societies. This is a systemic issue and, to be most effective, the percent of the society that engages in reuse and recycling behaviors needs to significantly increase over the next few decades.

Process skills

- observing
- inferring
- compare & contrast
- critical thinking
- creative thinking
- communicating
- analyzing
- synthesizing
- drawing conclusions

Habits of mind

- openness to new ideas
- reliance on data, facts & observations
- looks for connections
- investigates historical development of issue

Environmental ethics

- environmental awareness
- environmental understanding
- stewardship
- voluntary simplicity
- "green" consumerism

Disciplinary focus

- science
- geography

S14: **Learners can select an environmental problem of local concern** *(i.e. deforestation, industrial pollution, urban overcrowding, water pollution, and the like)* **and explain how the local problem is part of similar regional, national, and global issues. The learner can state some of the ways the problem is being addressed at all these levels.**

Content/Context

Unresolved local environmental issues become regional issues, and unresolved regional issues become global issues. Particulars of an environmental problem vary from region to region requiring slightly different responses of technical, political, lifestyle and other relevant changes. Most environmental problems involve disrupted sub-systems of larger ecosystems. Resolution of the problems involves determining what sub-systems are disturbed and determining actions that can restore them to health. Much can be learned by studying particular cases in specific locations

but the same strategies may have different results in other regions due to the interaction of social, political, and economic systems.

Process skills

- observing
- inferring
- predicting
- compare & contrast
- critical thinking
- creative thinking
- interpreting data
- estimating
- categorizing
- analyzing
- synthesizing
- drawing conclusions

Habits of mind

- openness to new ideas
- skepticism
- reliance on data, facts & observations
- looks for connections
- projects likely consequences of actions
- investigates historical development of issue

Environmental ethics

- environmental awareness
- environmental understanding
- stewardship

Disciplinary focus

- science
- interdisciplinary

S15: **Learners can describe several alternative approaches to pest control** *(genetic resistance, natural enemies, bio-pesticides, integrated pest management, and the like)* **and can indicate precautions that need to be taken in selecting, using, storing, and disposing of different classes of pesticides** *(chlorinated hydrocarbons, organophosphates, carbamates, botanicals, contact chemicals, systemic chemicals, soil sterilants, fungicides, and fumigants)* .

Content/Context

Humans have long resented other organisms that compete with them for resources or which use human bodies as a resource. Such organisms are generally referred to as pests. How much of a pest an organism is usually depends upon the size of its population and its appetite for materials humans covet. Over the centuries humans have developed a wide range of technologies to try to reduce or eliminate pest populations. Since the middle

of the twentieth century many chemical modes of pest control have been developed, many of which have severe long-term impacts on a broad range of organisms, including humans, other than the original target species. More recently, more benign technologies with a narrower target focus have been developed that bring about reasonable pest control with less negative environmental impact and fewer human health hazards.

Process skills
- observing
- classifying
- inferring
- predicting
- measuring
- compare & contrast
- critical thinking
- communicating
- interpreting data
- estimating
- categorizing
- analyzing
- synthesizing
- drawing conclusions

Decision-making skills
- suggesting potential alternative solutions
- projecting consequences of each alternative
- choosing among alternatives

Habits of mind
- curiosity
- openness to new ideas
- skepticism
- reliance on data, facts & observations
- looks for connections
- projects likely consequences of actions
- investigates historical development of issue

Environmental ethics
- environmental awareness
- environmental understanding
- stewardship
- voluntary simplicity
- "green" consumerism

Disciplinary focus
- science and mathematics
- social science
- interdisciplinary

SOCIAL STUDIES CENTERED

S16: **Given an environmental issue of their choice, learners can state:**
- **why management of the human use of the resource is needed;**
- **what human goals, values, and needs are at stake;**
- **who the management groups or individuals are likely to be; and**
- **what kind of scientific knowledge and technical skills are likely to be needed to accomplish sound management of the resource.**

Content/Context

Effective management of natural resources involves the application of scientific knowledge and technical skill to provide for the sustained use of these natural resources while protecting the quality of the environment for present and future generations. Management practices can range from no activity to extensive intervention in ecological processes. The development and enforcement of management policies and environmental laws are affected by economic factors, societal needs, ethics, politics, science and technology, and public and private interests. Specific local, state, and federal agencies or organizations are generally charged with the management of natural resources and protection of environmental quality.

Process skills
- classifying
- inferring
- predicting
- compare & contrast
- critical thinking
- creative thinking
- communicating
- interpreting data
- estimating
- analyzing
- synthesizing
- drawing conclusions

Habits of mind
- openness to new ideas
- skepticism
- reliance on data, facts & observations
- looks for connections
- projects likely consequences of actions
- investigates historical development of issue

Environmental ethics
- environmental awareness
- environmental understanding
- stewardship

Disciplinary focus
- social science
- science
- interdisciplinary

S17: **Given a local environmental problem** *(i.e. solid waste disposal, open space preservation, loss of biodiversity, ground water pollution)*, **learners can identify the issues involved, the key players and their viewpoints, assemble factual information, generate alternative solutions, project consequences of each solution, choose among the alternatives, and act on their choices.**

Content/Context

In order to survive, human beings make choices regarding how they will interact with the natural environment through their cultures, types of tool, application of technologies, and perspectives of their relationship to the natural environment. These choices either threaten or enhance a dynamic ecosystem. The environmental decisions made by one generation provide benefits and limitations for the next generation.

Process skills
- observing
- inferring
- predicting
- measuring
- compare & contrast
- critical thinking
- creative thinking
- communicating
- interpreting data
- estimating
- categorizing
- analyzing
- synthesizing
- drawing conclusions
- cooperative skills

Decision-making skills
- formulating operational definitions
- generating relevant questions
- gathering verifiable information
- suggesting potential alternative solutions
- projecting consequences of each alternative
- choosing among alternatives
- acting on choice
- cooperative problem solving

Habits of mind

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- curiosity
- openness to new ideas
- skepticism
- reliance on data, facts & observations
- looks for connections
- projects likely consequences of actions
- investigates historical development of issue

Environmental ethics

- environmental awareness
- environmental understanding
- stewardship

Disciplinary focus

- social science
- interdisciplinary

S18: **Given a choice of environmental problems** *(preferably local ones)*, **learners can determine the historical development of the problem and the issues that have been generated around the problem. They can further indicate how the historical development of the problem shaped the current problem and can then distinguish root causes from current symptoms.**

Content/Context

Every environmental problem has a history; that history usually involves several interacting systems that were once functional but have become dysfunctional as a result of one or more events. In order to propose a workable solution to the problem it is critical to know what the actions were, and are, that make and keep the systems dysfunctional. Sustainable correction for a problem can only really occur when the root causes, rather than surface symptoms, of the problem are addressed. It needs to become a basic habit of mind to search for root causes whenever an environmental problem is being addressed.

Process skills

- observing
- classifying
- inferring
- predicting
- compare & contrast
- critical thinking
- communicating
- interpreting data
- categorizing
- analyzing
- synthesizing
- drawing conclusions

Decision-making skills

- gathering verifiable information

Habits of mind

- openness to new ideas
- skepticism
- reliance on data, facts & observations
- looks for connections
- projects likely consequences of actions
- investigates historical development of issue

Environmental ethics

- environmental awareness
- environmental understanding
- stewardship

Disciplinary focus

- social science

S19: **Using an understanding of ecological, sociological, economic and political systems, learners can describe the complex relationships between and among such systems.**

Content/Context

People are components of ecological systems; and the sociological, the economic, and the political systems of people are thus operating within ecological systems. The consequences of sociological and political changes are reflected in the functioning of the ecological system in which the people are living, for example, the political choices of farm subsidies and support of huge agribusiness, impact the structure and fertility of soils that support the crops, livestock, and ultimately the people that use the foods. The connections between these human cultural systems and the ecosystem in which they are embedded is often overlooked or ignored. Both people and the ecosystem often suffer from such oversight.

Process skills

- observing
- inferring
- compare & contrast
- critical thinking
- communicating
- analyzing
- synthesizing
- drawing conclusions
- cooperative skills

Habits of mind

- curiosity
- openness to new ideas
- skepticism
- reliance on data, facts & observations

- looks for connections

Environmental ethics

- environmental awareness
- environmental understanding
- stewardship

Disciplinary focus

- social science
- interdisciplinary

S20: **Learners are able to locate the watershed in which their home and school are located and draw its rough boundaries on a topographic map. They can determine in what major drainage basin that watershed is located and they can also indicate the major ecosystems, resources, and major towns and cities that occur in that drainage basin.**

Content/Context

Watersheds are one of the most basic units of geographical understanding. Water distribution and flow is one of the key limiting factors of ecosystems. Waterways and flood plains have strong influence on the location of major human transportation lines and agriculture which in turn play a large role in the location of human settlements. Water distribution and flow have strong effects on erosion and deposition and therefore on soil development and distribution that may affect agricultural development. The dynamics of the watershed often have strong impact on the location and distribution of pollutants that affect both plant, animal, and human communities.

Process skills

- observing
- classifying
- inferring
- predicting
- measuring
- compare & contrast
- critical thinking
- creative thinking
- interpreting data
- estimating
- analyzing
- synthesizing

Habits of mind

- curiosity
- reliance on data, facts & observations
- looks for connections

Environmental ethics

- environmental awareness

- environmental understanding

Disciplinary focus
- social science
- science and mathematics
- interdisciplinary

S21: **Given a set of lifestyle descriptions from different cultures, ancient and modern, learners can indicate from those descriptions which aspects of the lifestyles are ecologically and economically sustainable and which contribute significantly to environmental degradation.**

Content/Context

Environmental problems are the result of misunderstanding, or lack of concern for the exploitation, of the nature and function of natural cycles, natural forces, and how living and non living factors interact to sustain life on earth. Over long periods of time individuals and groups interact with their environment in ways that either incorporate the natural systems and cycles and sustain themselves on the natural productivity in a sustainable fashion or they overuse the resources using not only the "natural interest" but also the "natural capital." The consequences of the latter behaviors often result in environmental problems of resource shortages, population explosion, habitat destruction, loss of biodiversity, and pollution of major life support systems.

Process skills
- observing
- inferring
- predicting
- compare & contrast
- critical thinking
- creative thinking
- interpreting data
- estimating
- categorizing
- analyzing
- synthesizing
- drawing conclusions

Habits of mind
- reliance on data, facts & observations
- looks for connections
- projects likely consequences of actions
- investigates historical development of issue

Environmental ethics
- environmental awareness
- environmental understanding

- stewardship

Disciplinary focus
- social science
- interdisciplinary

S22: **Given examples of past and present societies** *(e.g., Cro-magnon, !Kung, Babylonian, Mayan, Amish, American)* **learners can describe the major types of relationships, energy usage, and resource impact that humans demonstrated towards the environment. They can also describe how each society's attitudes and understandings of the functioning of nature influenced the impact of that society on their environment.**

Content/Context

The major activities of any society, securing food, creating shelter, and using time not devoted to sheer survival all have impacts on the environment. The specific nature of the activities has its own degree of positive or negative impact on the environment. The net sum of the consequences of these activities determines the degree of positive or negative impact of that society on the environment. In the developmental flow of societies from hunter-gatherer, to agricultural, to industrial most societies increased their negative environmental impacts and decreased long-term sustainability of the society.

Process skills
- observing
- inferring
- compare & contrast
- critical thinking
- interpreting data
- analyzing
- synthesizing
- drawing conclusions

Habits of mind
- curiosity
- openness to new ideas
- skepticism
- reliance on data, facts & observations
- looks for connections
- projects likely consequences of actions
- investigates historical development of issue

Environmental ethics
- environmental awareness
- environmental understanding
- stewardship

Disciplinary focus
- social studies

- humanities
- interdisciplinary

S23: **Given a war of their choice** *(i.e. American civil war, World War II, Korean or Vietnam wars, Mexican/American war, the French & Indian wars),* **learners can explain the effects that war has had on the cultures and environments of all parties to that war.**

Content/Context

Throughout human history, human migrations, conquests, and exposure to mass media have effected social change by forcing one culture to interact with another culture. The interaction between cultures through warfare has caused some cultures to disappear, others to change modestly, and new cultures to emerge. The technologies used in each war have varied effects on the natural environment where the wars occur.

Process skills

- inferring
- compare & contrast
- critical thinking
- interpreting data
- analyzing
- synthesizing
- drawing conclusions

Habits of mind

- curiosity
- openness to new ideas
- skepticism
- reliance on data, facts & observations
- looks for connections
- projects likely consequences of actions
- investigates historical development of issue

Environmental ethics

- environmental awareness
- environmental understanding
- stewardship

Disciplinary focus

- social studies
- science

S24: **Given a local environmental issue, learners can indicate the range of political options available to resolve it, state the political costs and benefits of each, and state the option they support under the circumstances, and why.**

Content/Context

Political options for resolving any environmental issue range from simple persuasion to dramatic confrontations. Each option is effective within a given range of conditions. Each option has its benefits and drawbacks. Choice of any particular option often requires making tradeoffs between benefits and drawbacks. To be an effective citizen, one must be aware of the options, their benefits, and drawbacks and be able to make decisions about which option is most likely to produce the desired results.

Process skills
- inferring
- predicting
- compare & contrast
- critical thinking
- creative thinking
- interpreting data
- analyzing
- synthesizing
- drawing conclusions

Decision-making skills
- formulating operational definitions
- generating relevant questions
- gathering verifiable information
- suggesting potential alternative solutions
- projecting consequences of each alternative
- choosing among alternatives
- cooperative problem solving

Habits of mind
- openness to new ideas
- skepticism
- looks for connections
- projects likely consequences of actions
- investigates historical development of issue

Environmental ethics
- environmental awareness
- environmental understanding
- stewardship
- voluntary simplicity
- "green" consumerism

Disciplinary focus
- social studies
- interdisciplinary

S25: **Given an environmental issue** *(such as toxic waste plant siting, lead paint, asbestos removal, land use restrictions for endangered species)* **the learner can identify related "equity " issues and suggest ways they may be addressed in a fair manner.**

Content / Context

Every potential solution to an environmental problem has its own set of potential consequences. These consequences will affect different social groups in different ways and some groups more disproportionately than others. Environmental decision-making usually involves some tradeoffs among costs and benefits and among the burden to be born by different classes of people. A broad spectrum of Americans believe that attempts should be made to distribute the benefits and burdens of environmental decisions as equitably as possible. Students need to be given opportunities to develop decision-making skills that reflect such equity.

Process skills

- inferring
- predicting
- compare & contrast
- critical thinking
- creative thinking
- interpreting data
- estimating
- categorizing
- analyzing
- synthesizing
- drawing conclusions

Decision-making skills

- gathering verifiable information
- suggesting potential alternative solutions
- projecting consequences of each alternative
- choosing among alternatives
- cooperative problem solving

Habits of mind

- openness to new ideas
- skepticism
- reliance on data, facts & observations
- looks for connections
- projects likely consequences of actions
- investigates historical development of issue

Environmental ethics

- environmental awareness
- environmental understanding
- stewardship

Disciplinary focus

- social science

S26: **Learners will be able to explain how birth rate, death rate, fertility rate, and immigration influence the growth of a population within a state or nation. Learners can predict how rate of growth impacts economic systems ecosystems, political systems, and social systems. Learners can read and interpret graphs of age and sex structure of a local population and indicate how the data will impact future needs of the community for schools, cemeteries, and other needs that will impact the local environment.**

Content/Context

Human populations, like those of other species, grow through the interactions of birth, death, and fertility rates and the rate of immigration. Human population has been increasing exponentially in many regions of the planet. Each new person puts added demand on the natural resources of the planet which is further complicated by the varying per capita rates of consumption of the different countries. Availability of access to basic resources of food, water, and shelter affects birth, death, and fertility rates and alters the end population result. Two factors must always be considered: rate of population increase and the base upon which the rate is functioning. There are many consequences of population increase and decrease, and the net sum of these affects the quality of life and the health of the environment.

Process skills

- observing
- classifying
- inferring
- compare & contrast
- critical thinking
- interpreting data
- estimating
- analyzing
- synthesizing
- drawing conclusions

Decision-making skills

- formulating operational definitions
- generating relevant questions
- gathering verifiable information
- projecting consequences of each alternative
- cooperative problem solving

Habits of mind

- reliance on data, facts & observations
- looks for connections
- projects likely consequences of actions
- investigates historical development of issue

Environmental ethics

- environmental awareness

- environmental understanding

Disciplinary focus
- social science
- science and mathematics
- interdisciplinary

S27: **Learners can select a suggested solution to a local environmental issue of their choice and prepare a risk/benefit analysis of that particular solution. The learner can explain the risks and benefits of the solution to others and offer a reasoned opinion of the potential usefulness of that particular solution.**

Content/Context

Every alternative solution to an environmental issue has its risks and benefits to both the environment and to people in the environment. In order to make considered choices from among alternatives, people need to be aware of the risks and benefits involved with each alternative. Often a final choice involves tradeoffs between the specific risks and benefits of two or more of the potential choices. Risks and benefits involve a variety of factors—ecological, human health, economic, social, and the like. A good risk/benefit analysis involves information from as many of these areas as possible.

Process skills
- classifying
- inferring
- predicting
- compare & contrast
- critical thinking
- creative thinking
- communicating
- interpreting data
- categorizing
- analyzing
- synthesizing
- drawing conclusions
- cooperative skills

Decision-making skills
- generating relevant questions
- gathering verifiable information
- suggesting potential alternative solutions
- projecting consequences of each alternative
- choosing among alternatives
- cooperative problem solving

Habits of mind
- openness to new ideas
- reliance on data, facts & observations
- looks for connections

- projects likely consequences of actions
- investigates historical development of issue

Environmental ethics

- environmental understanding
- stewardship

Disciplinary focus

- interdisciplinary

S28: **Given an environmental issue of their choosing, learners can cite some local, state, and national laws that address that issue and indicate the degree of impact the laws have had in addressing the issue. Learners can also suggest ways they believe some of the laws should be altered to be more environmentally effective and/or socially equitable.**

Content/Context

Democratically developed laws are a major tool used to address resolution of environmental problems. The law-making process usually involves a great many compromises relative to issues of the problem. The resulting law may be too lax or too restrictive for various political factions. Implementation of a law often involves development of a code of regulations administered by a governmental agency and overseen by a law enforcement body. Funds for law and regulation enforcement are often inadequate to do the job. Education is another tool of implementing laws. When individuals know and understand the rationale of a law or regulation they are more likely to voluntarily comply with the law thus reducing the demand for coercive law enforcement procedures.

Process skills

- inferring
- predicting
- critical thinking
- creative thinking
- communicating
- analyzing
- synthesizing
- drawing conclusions
- cooperative skills

Decision-making skills

- formulating operational definitions
- generating relevant questions
- gathering verifiable information
- cooperative problem solving

Habits of mind

- openness to new ideas
- skepticism
- reliance on data, facts & observations

- looks for connections
- projects likely consequences of actions
- investigates historical development of issue

Environmental ethics

- stewardship
- voluntary simplicity

Disciplinary focus

- social science
- interdisciplinary

LANGUAGE ARTS & HUMANITIES

S29: **Learners using a diversity of examples can demonstrate their understanding of different environmental ethics that are practiced within societies currently or throughout history.**

Content/Context

Ethics is concerned with those things which are considered to be "right" or "wrong" actions or behaviors. Ethics tend to emerge from particular world views. Thus different cultures and subcultures have their own ethics about what is the proper relationship between humans and the rest of nature and between one human group and another. Each ethical viewpoint acted upon has environmental consequences. It is instructive to identify different ethical viewpoints and recognize the environmental consequences of such actions or behaviors.

Process skills

- observing
- classifying
- inferring
- predicting
- compare & contrast
- critical thinking
- creative thinking
- communicating
- interpreting data
- analyzing
- synthesizing
- drawing conclusions
- cooperative skills

Decision-making skills

- projecting consequences of each alternative
- choosing among alternatives

Habits of mind

- curiosity

- openness to new ideas
- skepticism
- looks for connections
- projects likely consequences of actions
- investigates historical development of issue

Environmental ethics

- environmental awareness
- environmental understanding
- stewardship
- voluntary simplicity
- "green" consumerism

Disciplinary focus

- language arts & humanities

S30: **Learners can articulate and defend an environmental ethic and give examples of how that ethic impacts choices they make in their daily lives.**

Content/Context

Faced with immediate choices, people often use ethical principles to guide decision making when time does not permit carefully researched and reasoned approaches to making decisions. There are a variety of ethical positions that can be considered to be environmental in nature. They range from wise use positions, to stewardship positions, to animal rights positions, and the like. They are usually based in some world view of the place of people in nature and the rights and privileges perceived to be part of the world view. Ethical viewpoints are often acquired non-verbally from family and community; it is valuable to consciously recognize the ethical viewpoints held by self and others and to be able to articulate them.

Process skills

- observing
- classifying
- compare & contrast
- creative thinking
- communicating
- interpreting data
- synthesizing
- drawing conclusions

Decision-making skills

- suggesting potential alternative solutions
- projecting consequences of each alternative
- choosing among alternatives
- acting on choice

Habits of mind

- looks for connections
- projects likely consequences of actions

- investigates historical development of issue

Environmental ethics

- stewardship
- voluntary simplicity
- "green" consumerism

Disciplinary focus

- language arts & humanities

S31: **Given a novel or short story, television or movie drama, the learner can infer or recognize the environmental setting of the fiction and give an opinion of how that environment affected the development of the story and the lives of the chief characters.**

Content/Context

Every story takes place in some environmental context. That environment may be carefully described by the author or it may be inferred from characters and actions of the story. The environment, in its broadest context of biophysical, social, or mind/body, affects the characters and their behavior. This may be done implicitly or explicitly. Examination of a work of fiction should include determining what the environmental components are and how they affect the characters and their actions.

Process skills

- observing
- inferring
- compare & contrast
- critical thinking
- creative thinking
- interpreting data
- analyzing
- drawing conclusions

Decision-making skills

- generating relevant questions
- gathering verifiable information

Habits of mind

- curiosity
- openness to new ideas
- reliance on data, facts & observations
- looks for connections
- projects likely consequences of actions
- investigates historical development of issue

Environmental ethics

- environmental awareness
- environmental understanding

Disciplinary focus

- language arts

APPENDICES

Process and Decision-making Skills Glossary

Process Skills

observing—taking notice of ones surrounding using any or all the senses.

classifying—grouping items into classes that have systematic relationships.

inferring—deriving meaning by reasoning or implication from a set of observations or data.

predicting—foretelling the probable outcome of activities and actions.

measuring—using standardized instruments to determine the quantity, capacity, dimensions, degree, or the like of anything.

compare & contrast—examining two or more items to determine the ways in which they are both similar and different.

critical thinking—using logical reasoning to resolve problems and issues.

creative thinking—using intuitive reasoning to resolve problems and issues and find unusual ways to explore problems and issues.

communicating—sharing ideas, views, thoughts and opinions with others.

interpreting data—explaining the meaning of observations or other data.

estimating—calculating the approximate size, value, or worth of something.

categorizing—creating groupings and defining their properties.

analyzing—separating the parts of a whole and revealing the relationships of the separate parts to the whole.

synthesizing—consolidating sets of parts and their functions to create an an integrated whole.

drawing conclusions—summing up discourse and making a reasoned judgement based on all the available information and observations.

cooperative skills—interpersonal actions to achieve successful group efforts of observation, critical, and creative thinking and problem solving.

Decision-making skills

formulating operational definitions—clarifying the problem or issue which requires decision-making and defining as precisely as possible what all of the factors are that are to be explored.

generating relevant questions—making lists of questions to be answered that require gathering information that clearly and strongly tied to the decision that needs to be made.

gathering verifiable information—gathering information and data that can be confirmed by several sources.

suggesting potential alternative solutions—generating a variety of possible solutions to the problem under study.

projecting consequences of each alternative—examining each alternative to determine what are the probable outcomes to be expected from taking the proposed action.

choosing among alternatives—examining personal and group values and using them to make a choice from among the examined alternatives.

acting on choice—moving from making a decision to acting on the decision.

cooperative problem solving—working with others to examine problems and issues and working with others to implement cooperative choices.

Using Environmental Literacy Benchmarks In Curriculum Development

The Role of Environmental Literacy Benchmarks

The environmental literacy benchmarks are a set of tasks that can be accomplished effectively only if learners have acquired and can use sets of information, skills, and attitudes. The benchmarks are a curriculum design and assessment tool, not a curriculum in environmental education. Learners can gain the knowledge, skills, and attitudes from a variety of education venues—school, home, community, media, interest groups, churches, and the like.

Schools and Environmental Literacy

It is assumed that a primary source of the development of environmental literacy will be the schools, particularly in terms of knowledge and skills. Schools are the places where the most organized presentation of information and skill development occurs. There are, however, a number of different ways of presenting the information.

Curricular Alternatives

Some schools will choose to present this as a distinct course with the primary objective of increasing understanding of how the natural world functions and may create courses titled something like "environmental science." Other schools will see that environmental literacy has components from a broad spectrum of traditional courses and will try to assure that appropriate concepts are developed within such courses as history, geography, mathematics, science, and language arts. Still other schools organize curriculum around key themes that develop all the basic skills using the theme as an organizer, indeed, environmental topics are often key organizers for such programs.

Each of these curriculum structures has its pluses and minuses. Different students respond positively or negatively to each. It is both the prerogative and the opportunity for each school system to select the curricular approach which in their opinion assures that students in that school are provided with the knowledge and skills to meet the benchmarks appropriate to their grade levels. The benchmarks are essentially assessment tools to determine the degree of effectiveness of each school to develop and nurture environmental literacy within its student body.

Benchmarks are designed not to tell learners what to think but to assure that they have developed the understandings and skills needed to think, feel, and

act in ways that preserve the integrity of the environment to meet not only their immediate physical, social and emotional needs but the needs of generations yet to come. Learners need to be empowered not only to deal with current human/environment interactions and issues, but to perceive and head off potential negative environmental issues in the future.

Getting the Job Done

Teams of educators from each school need to review their curricula and determine the best places to insert the kind of information and skill development that will assure that learners can meet the grade appropriate benchmarks for the learners they guide. It will take some experimenting at each school to assure that their plan is working over several years of effort.

A growing body of instructional materials is available and more is being developed all the time to help teachers and youth leaders develop and foster critical environmental knowledge and skills. Each of these materials makes a contribution to a learner's developing environmental literacy, if the learner is exposed to them.

Teachers have often had limited exposure to environmental understandings and critical and creative thinking skills and environmental decision-making skills in their own educational development. These teachers need involvement in inservice training to give them the basic security to guide younger learners toward environmental literacy. An increasing number of environmental agencies and non-profit groups are prepared to offer just this kind of inservice training. The booklet, ***Environmental Education in Massachusetts,*** lists many of these groups and exciting locations for environmental education for learners of all ages.

Administrators and school committee members need to formally establish environmental literacy as one of the major goals of their local educational system and work with curriculum coordinators and teachers to see that an effective program is put in place so that graduates at each level are able to meet the appropriate benchmarks. This involves not only the day-to-day instructional opportunities but opportunities for older students to apply their knowledge in productive community service activities in cooperation with other community agencies and organizations.

The end product of developing environmental literacy is a citizenry properly informed, properly sensitive to environmental concerns at all levels, and empowered to take responsible action to assure a healthy environment for the present and the future. Environmentally literate and responsible citizens are much more likely to act in ways that prevent ongoing environmental degradation and reduce the need for overly burdensome governmental regulation.

Benchmarks Cross-referenced by Category

Individuals may have specific interests within the development of environmental literacy and may focus on different aspects of the development. To make this document more user friendly, the following listing of benchmarks by category is provided.

- **Ecologically related**

E1, E2, E4, E5, E7, E8, E9, E20, M1, M2, M4, M11, S1, S2, S3, S4, S5, S6, S7, S8, S11, S12, S13

- **Conservation and Waste Management related**

E6, E15, E16, E21, E22, E23, E24, M6, M7, M8, M9, M20, M21, M22, M30, S13, S15, S20

- **Social Environment related**

E18, E19, E27, M12, M29, M30, S16, S17, S18, S21, S22, S23, S34, S25, S26, S27, S28, S29, S30, S31

- **Mind/Body related**

M24, S9, S29, S30

- **Community Problem-solving related**

E25, E26, M19, M23, M25, M27, S12, S14, S15, S16, S17, S26, S27

- **Systems related**

E3, E5, M3, M15, M17, S7, S10, S19

- **Change related**

E10, E14, M5, M10, M12, M13, M16, M18, S8

- **General Science related**

E11, E12, E13, M14, M28, S9

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